A critical analysis of e-waste policies

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A Critical Analysis of E-waste Policies

by

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I. Preface

In 2009, after I came across some shocking photos about the informal electronic waste (e-waste) recycling centers in China, I started seeing a whole different picture as I looked through my laptop monitor. Just like many others who are still not aware of the damages their obsolete electronic devices might create, I had never really thought about what could have been happening to discarded electronics. For sure, the option that they might be travelling all the way to China or Africa to become a manual dismantling or recycling work at the hands of a child labor would be the last thing I would have ever thought! Maybe that is why, I felt an instant guilt the moment I saw those photos, remembering the non-working cell-phones of our family that my father 'somehow' got rid of a couple of months ago. The possibility that they could be laying around in a river in for instance Africa, or poisoning an innocent person gave me the urge to investigate and understand the underlying dynamics of the thousands of kilometers long trans-boundary movement e-waste makes. I was so full of emotions about the topic, that I might have even thought naively that if I research enough and think hard on the subject, I might be able to bring 'the solution' to the problem!

Maybe due to this naive but perfectionist approach, especially the initial parts of the research process were quite difficult. Existing approaches towards understanding the problem in the literature were not really covering all the aspects. As I read more and more, I started to develop and conceptualize a critical backbone for evaluating the problem. This creation process was certainly not easy; while trying to juggle with all the concepts and making logical connections with each other, I once again realized how complicated it is to make social sciences. In spite of the difficulties I have been through, I am glad that I made that step to explore this interesting discipline, after my engineering degree. I have gained invaluable insights about the world we live in during this journey.

My supervisor Erik van der Vleuten is certainly one of the most important people of my life at TU/e. Through my working experience with him, I have learned the importance of collaboration and openness; that asking for help is the most normal and natural step to take when you feel like getting lost in your work. Seeing how much he trusted in me made me become more aware of my competences as a critical researcher and have the courage to continue in this creative process.

My second supervisor Saurabh Arora has had an invaluable impact on this thesis during the limited time he could contribute. His expertise in critical approach brought me face to face with the weak parts of my argumentations. I have enjoyed our scholarly discussions a lot, although they were often very challenging.

I am thankful to both of them. My world has become richer and my vision of this world got broader with the things I have learned from them.

Finally, thank you my dear Lars for your limitless patience, understanding and support. You give me the aspiration to become a better person every day.

II. Abstract

E-waste is a complicated sustainability problem with three aspects: volume, health & environmental hazards, and trans-boundary movement. The disciplinary angles in the literature do not cover all these aspects at once while addressing the issue. Critical literature asserts that most of the policy proposals on sustainability issues are dominated with a production oriented approach, neglecting the damages created by over consumption and free trade. Moving from these debates, I have argued that majority of the solution proposals on e-waste have been dominated with a production oriented approach, which has a primary focus on better technologies as the primary solution of the problem. Moreover, although it is a root cause, the damage created by increasing volumes of e-waste tends to be disregarded, because over-consumption of electronics is not questioned enough. Consumption is the source of continuing economic growth, according to mainstream economics. With the promotion of transformation into a knowledge economy especially for developed countries and the role ICT plays for that, consumption of electronics has become the new source of this economic growth and scholars mostly avoid proposing methods for its reduction. Similarly, although e-waste and used electronics trade has failed to bring the promises of the free trade paradigm for all the involved parties and created tremendous environmental and health damages, most of the solution proposals refrain from accepting the incompatibility of the paradigm with sustainability related issues. The critical discourse analysis of six governmental and non-governmental organizations crucial for e-waste policy-making reveals similar patterns in the discourse of these actors as argued by the critical literature. Although different voices also exist, the discourses of the organizations, which have strong influential power on global e-waste policies, are dominated by these three approaches. This will probably have direct practical implications on the global e-waste policies and the future of the e-waste problem.

Contents

1. Introduction

The tranquil side of watching movies, which involve unpleasant, dystopian future-telling about the world, emerges at the moment the audience remembers that it is 'just a movie' and those horrible events will never happen in 'the real world'. The cult Mad Max trilogy directed between 1979 and 1985 is among these movies that tell the story of people trying to survive in a post-apocalyptic world[1]. In my opinion, the most shocking thing about the movie is especially how the now-human friendly technology and technological appliances which are designed to look nice and fit well into the daily lives of people transform cities into ugly metal messes. When we look closer, we realize that this is because old and unused stuff, all kinds of waste but especially waste of technological appliances like cars, TVs are all around; they are not collected by an authority like municipality anymore. Livelihoods are filled with technological trash. The grey color and the metallic touch widely used within the movie on a variety of substances from people's clothing to the cars used in those times reveal the not-so-appealing face of technology that we do not often encounter in our daily lives. Fortunately Mad Max is just a movie, and the pessimistic and unpleasant picture of the world drawn in the movie is not real. The electronic appliances that we as the members of Western modern societies know look nice and new, while we are using them, while they take place in our lives. When they become not useful anymore, and we decide to discard them, they are taken away from our sight and we hardly see their ugly, old faces. But where do they go?

The photos from the town named Guiyu might mislead you about the reality of the scenes you see: The metal mountains of electronic equipment on top of each other, ranging from old computer screens, mobile phones to televisions and fridges; rivers flowing in metallic black color filled with metal scraps, the grey-smoky nature of the sky make you believe that the images should be from the set of a new Mad Max movie. Unfortunately, they are true: Guiyu is a city in the 'real world', located in the Guangyong province, on the South China Sea coast. It is known as the largest electronic waste site in the world, where thousands of ex-farmers are engaged in primitive e-waste cycling operations (Yu et al., 2006). Guiyu is one of the many places to where waste electronic equipment from many developed countries go, once consumers decide to get them out of their sight, just like Bangalore in India, Lagos in Nigeria and Agbogbloshie in Ghana.

Electronics industry is the fastest growing industry at the moment (Grossman, 2006). The speed of improvements in the industry, especially in ICT (Information and Communication Technologies) is mind-blowing, with a variety of products and services emerging every day, and the increasing role these services take in our daily lives. Simultaneously, the negative impacts of these developments especially on the environment have been rising: According to UNEP (2005) 20 to 50 million tons of electronic waste (e-waste) is generated annually worldwide.

The industry is widely known as the clean and safe engine of economic growth especially once compared to the traditional industries such as energy and transport. It is not easily associated with negative impacts on environment and human health, particularly in Western societies. That is why, once photos from e-waste handling sites in various parts of the world, such as Guiyu or Bangalore started to emerge, they shocked many people who were completely unaware of any environmental degradation caused by electronics industry.

E-waste is one of the most important sustainability related problems of this industry. Surveying the related literature, we can divide this problem into three major (and interdependent) aspects: 1. The volume problem (e-waste produced world-wide increases in enormous amounts

[1] http://www.madmaxmovies.com/ Retrieved on 12.03.2011.

annually, landfill spaces are rapidly decreasing); 2. Health and Environmental Damages (from land filling as well as improper e-waste recycling and processing); 3. Trans-boundary Flows of E-waste (Second hand usable or broken electronic equipment exported legally or illegally to developing countries, creating mountains of e-waste in poor and disadvantaged regions).

I have started this research with a special interest on the trans-boundary aspect of the e-waste issue, believing that it is the most problematic side that needs urgent attention from related policy actors. However later during my research I have come to the conclusion that focusing only on the dynamics and consequences of the international e-waste movement will shed light on a very limited part of the complete e-waste problem. In particular the e-waste policy literature and policy reports of national and international organizations tend to investigate only one of the aspects. Especially the volume aspect of the problem is neglected, and solution proposals tend to focus on managing and recycling e-waste sustainably (Health and Environmental Damages) and diminishing the illegal e-waste traffics (Trans-boundary Flows of E-waste). These approaches tend to focus mostly on how to *manage the problem* without a careful and detailed analysis of *the emergence of the problem*. Within the Innovation Sciences such studies tend to approach e-waste problem as a waste disposal and management issue and develop technologies and methods for the efficient and sustainable management and recycling of e-waste.

I argue that these policies (and much of the scientific literature) focus on the symptom and largely neglect the root causes; indeed, by doing so they help to *normalize* the unsustainably increasing volume of electronic waste. And yet we know from Innovation Sciences and in particular Sustainability Transition Studies that "the real environmental risk is of a sweeping convergence in what people take to be normal ways of life, and a consequent locking in of unsustainable demand for the resources on which these ways depend" (Shove, 2003, p.416). Scientific research that aims at (or takes for granted) new sustainable technologies and systems to solve unsustainable patterns of demand and consumption may unintentionally and unknowingly assist the reproduction of these patterns (Shove, 2003).

A few scholars have addressed this problematic side of the current e-waste literature and call for a new approach, which covers all three aspects and the dynamics shaping them (Lepawsky & Mcnab, 2010). This thesis follows up on this call and has two major goals. The first is to understand the origins of the e-waste problem and its interrelated sub-problems; the way these are created, reproduced and are related with each other. In this way I hope to contribute to the absence of a comprehensive approach in the literature and create a research agenda that can be used in the future. The second goal is to use this approach for critically analyzing and evaluating the policy proposals of the major institutions and organizations in the field.

The thesis is divided into three major stages. In the first part (**Chapter 2**) I make a broad literature research to understand and monitor the way the e-waste problem has been defined and analyzed so far. The insights gained from this literature review form the bricks of the analysis of the critical argumentations on e-waste problem that I conduct in part 2 (**Chapter 3**). Here I use the critical literature in a creative way, combine related phenomena from different disciplines into one single critical scheme. In the third and final part (**Chapter 4**), I use this scheme to make an empirical analysis of the policy proposals from organizations and institutions related to e-waste. I make a critical discourse analysis of the recent policy papers published by the 6 major institutions and organizations, which are the EU (European Union) (Intergovernmental Organization), Greenpeace (Non-Governmental Organization), USEPA (United States Environmental Protection Agency-Governmental Organization),Step Initiative (Non-Governmental Organization), and Japanese Ministry of Environment (Governmental Organization), the Basel Convention (Intergovernmental Organization). I finish the thesis with the primary observations I have concluded through the research (**Chapter 5**).

The thesis is written in a format that resembles more like a longer and more detailed scholarly article than a report. That is why the core academic components of the thesis, such as methodology, research questions, findings etc., have been embedded in the text to keep the narrative structure uninterrupted, rather than several separate sections. In line with this approach, the methodologies used throughout the thesis are explained at the beginning of the relevant chapter where the particular methodological tool has been implemented.

2. Literature Review

To have a detailed grasp of what exactly the e-waste problem is, I have reviewed the related scholarly literature. As an Innovation Sciences student, my focus was on policy studies. In this chapter, I explain the findings of this review in two parts. First, I give a brief summary of the policy oriented perspectives on the issue. In the second part, I describe the e-waste problem and the three major aspects in a comprehensive approach.

2.1. Policy Oriented Perspectives on E-waste in the Literature

The e-waste problem has taken moderate interest in the literature from different disciplines and has been analyzed from a number of disciplinary lenses. In this part, I review these angles that have been used in the literature. Although they are analyzed in separate sections, most of them have common points and linkages.

Criminology

As the e-waste issue becomes more intractable on the transnational scale and more players are included into trade chains, it becomes more difficult to bring an effective solution to the problem. It is understood that national proposals might inevitably fail unless global measures are not taken. Even if some of the trade chains can be controlled, e-waste will find new routes and create new recycling/disposal markets. That is why, criminal justice and criminology studies focus on global governance and ways to control the involvement of companies with illicit activities. Deterrence strength of fines, imprisonment, and effectiveness of motivators like public subsidies or tax benefits are discussed within this literature.

Some of the criminology studies tend to characterize e-waste as merely an organized crime issue, and focus on developing preventive solutions especially against the involvement of companies and corporations (Liddick, 2010). As a result, they propose solutions on deterrence and sanction methods that will decrease the tendency of corporations to be involved with illegal activities. However, not including the wide range of societal players and political dimensions of the issue creates the major inadequacy of this approach. Increasing the costs of making economic benefits out of illegal e-waste trade might bring some benefits to improve the situation, but it leaves major parts of the problem still under the covers.

Gibbs et al. (2010) explain that the difficulty of controlling the trans-boundary movement of materials is rooted in the diversity of global and local regulations and the inadequacy of some local governments with implementing regulations. Although global regulations on business transactions have increased since 1970s, most of the regulations are still local. Moreover, these international regulations are most of the time accepted and implemented on a voluntary basis. This means that countries are free to choose to ratify the treaty, and when they do not ratify, there are hardly any sanctions. Furthermore, in most of the cases the ratifying countries can still lack the internal capabilities to actually implement the rules of these treaties (Gibbs et al., 2010). As a result, the variety and number of potential victims as well as possibilities for white-collar crime and illegal trans-boundary operations increase (Gibbs et al, 2010). Moreover, as the scale of transactions gets larger, it can become even more difficult to monitor and detect illegal activities since these transactions have a complex nature due to the variety of actors involved. Information about the characteristics of the shipped material can easily be misrepresented when they cross borders. Empirical findings about e-waste transports reveal that this is particularly true: some containers which are reported to be filled

with second hand working computers appear to be waste electronics parts after inspections, or illegal exporters bribe officials at the customs to change the classification of the containers from waste to second hand reusable equipment.

Criminology studies evaluate e-waste issue as a weak control problem and focus on the flow of e-waste as a commodity. According to the way they categorize the role of corporations, these studies can be divided into two groups: The first group of research emphasizes the role of corporations and takes them as the central point of analysis (Gibbs et al, 2010). They focus on e-waste traffic conducted by the white-collar employees and develop policy solutions to prevent crimes of corporations. These studies analyze the corporation as a whole entity, which violates certain rules due to low external monitors and the belief that consequences will not be too severe compared to the tempting arrangements and their profitable results. On the other hand, the second group of research suggests that corporations should not be the central focus point. Individual actors, who have decision making power within e-waste transactions as well as the broader system in which they find the space to operate illegally, should be targeted during policy making (Rothe, 2010). Nevertheless, these two groups share a common point: they analyze e-waste traffics from a crime prevention point of view and discuss which methods can be the best to stop actors violating the rules. They accept these traffics as given and do not necessarily investigate the factors that have shaped their emergence.

Environmental Justice

Global injustice that trans-boundary e-waste flows create is one of the crucial points discussed in the literature. Users of electronic products enjoy the benefits; however once these products become obsolete, they follow international routes and are disposed at poor regions of developing countries. E-waste is handled under improper conditions, most of the time manually by people who work at the bottom of the informal recycling chain and live below the poverty line (Öko-Institut, 2010). They bear the health and environmental costs of cheap e-waste processing. Thus, the cost of increasing consumption of electronics is being paid by the people, who can hardly afford to own these equipments. There is an uneven distribution of benefits and costs of electronic products. It is disputable whether the economic benefits of e-waste for these people are as high as the health and environmental costs they are paying. However, a case study conducted by German organization Öko-Institut in Ghana shows that for instance the money recycle workers earn in Ghana is still not enough to raise them above the poverty line (Öko-Institut, 2010).

The environmental justice framework is one of the most suitable approaches for understanding the distributional implications of environmental changes. The approach looks for social justice issues in two dimensions: distributional and procedural justice. The first considers how health and environmental costs are distributed among different groups of people and communities; while the latter seeks how decision and policy making processes are shaped; whether there is fair contribution from all related actors in the agenda and whether regulations are prepared through equal participation of various ideas. While analyzing these two dimensions, researchers need to focus especially on the distribution of costs and benefits in the social and spatial contexts, causes of the environmental change considering various levels of the problem and the impacts of the environmental change over space and time.

In poor countries there are large numbers of labor, who are willing to work in recycling and disposal processes, for very low wages and without any health precautions. Importers and small workstation owners make profit from e-waste flows by exploiting these people, who desperately need a job to be able to meet their basic needs. The documentaries made in the disposal fields and interviews with the manual labor show that although these people often realize the harmful effects of their jobs on their health status, they inevitably choose to continue working, because they do not have

many choices to earn income[2] (Öko-Institut, 2010). Most of the time, communities and regions which are economically and socially under developed are the destination zones for waste disposal, landfills and other toxic processes.

Nevertheless, as Lepawsky and Mcnabb (2010) also suggest, the trans-boundary traffic of e-waste is a much more complex story than the manner environmental justice approach handles it as the case of rich countries dumping their e-trash to poor countries. Their study shows that as well as inter-regional trade, that mainly occurs from the developed North and West to the poor countries in the East and South, the intra-regional trade is also an important source of e-waste being carried to poor regions. Their statistical analysis illustrates that indeed the streams of e-waste tend to be from rich countries to poor countries, however they have also observed patterns that complicate the basic assertions the environmental injustice approach, that e-waste trade is only from rich to poor countries. For instance, they have found that developing countries also have e-waste trade between each other.

Ecological Modernization and Sustainable Development

Founded by Joseph Huber, environmental modernization theory (EMT) basically suggests environmental protection and economic growth can be achieved at the same time through the collaboration of government and industry during environmental policy making. For this, structural change in the system towards less environmentally burdensome ways of wealth generation should be targeted, and new technologies that are more environmentally efficient should be developed to achieve economic benefits at the same time. Government's role would be more at macro level with making strategic planning and developing innovative policy instruments, while industry is responsible with developing new technologies (Janicke, 2008). Thus, environmental problems can be solved and pollution can be continuously reduced through the development and implementation of environmentally sound inventions and innovations.

According to EMT, it is believed that market economy is the most effective system that ensures responsiveness and flexibility from the industry towards the promotion of ecological adaptations of current industrial dynamics. For this, the strategic target is to shift macro-economy from energy and resource intensive sectors towards service and knowledge intensive sectors. Thus, the non-stop acceleration of ICT technologies as it is promoted as the clean technology is good for the economy and the environment.

Studies on e-waste from EMT approach are mostly on efficient and sustainable management of e-waste and how to improve the e-waste handling systems of particularly developing countries. They perceive the e-waste problem as a waste disposal and management issue (Hashi and Mori, 2005; Herat, 2007; Khetriwal et al., 2005; Schluep et al., 2009).

2.2. E-waste Problem

The impact of electronics industry on the environment has started to take interest in research since the 1990s (Williams, 2005). In this section, by going through this literature I explain how the problem of electronic waste can be described. First, I show the variety of definitions the term e-waste has acquired. Later, I analyze the problem through the three major aspects that have been focused on in the literature; namely the volume aspect, health and environmental damages and trans-boundary movement aspect.

[2] http://youtu.be/ZHTWRYXy2gE A short documentary by Journeyman Pictures shows the e-waste processing in China explicitly. Retrieved on June 2011.

How to Define E-waste?

One of the most characteristic problem about e-waste starts already with its definition and classification. The concept is still ambiguous and lacks a clear definition that can be applicable worldwide. It is difficult to speak about an international consensus about what should be counted as electronic waste, what can be accepted as scrap material or second hand equipment; and by various sources this is accounted as one of the reasons that make the contemporary e-waste problem difficult to solve (Zoeteman et al., 2010). In addition, the amount of e-waste produced globally and the routes of the international flows are very difficult to determine, because of the difficulty of gathering reliable information (Widmer et al., 2005).

For instance, the e-waste description proposed by the European Union (EU) Directive on Waste Electrical and Electronic Equipment[3] (WEEE) includes waste of a broad range of products, changing from all household appliances (such as fridges and radios) to Information and Communication Technologies (ICT)[4] gadgets such as personal computers, laptops, I-Pods and cell phones; consumer equipment and lighting equipment (EU, 2003). Compared to the definition of the EU, the US Environmental Protection Agency (EPA) defines e-waste under a narrower classification, including personal computers (PCs) with desktops, portables and computer monitors; televisions with VCRs and stereos; computer peripherals with printers, scanners and fax machines; computer mouse and keyboards; cell phones (EPA, 2008).

Volume Problem

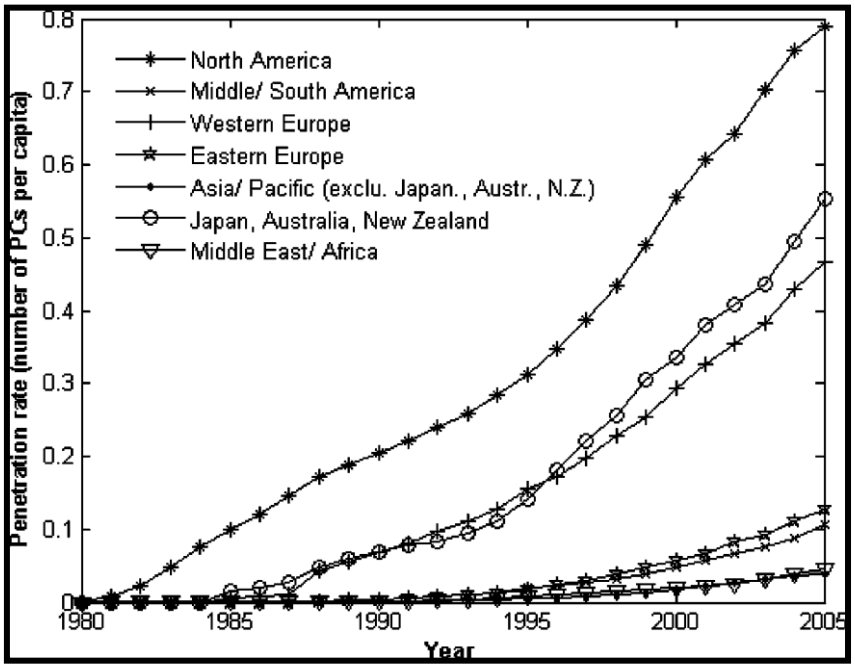
The first problem is the increasing volume of e-waste produced globally. However, the discrepancies between the definitions of e-waste reflect on the calculations of e-waste production. There is no single study or report in the literature that asserts to have found almost exact numbers. Moreover, the assumed amounts are mostly between wide ranges. For instance according to UNEP (2005) 20 to 50 million tons of e-waste is generated annually worldwide. Among this amount, e-waste produced by the 27 member countries of the EU is estimated to be around 7 million tons (Zoeteman et al, 2010), 3 million tons by the US (Kyle, 2011) and 2.3 million tons by China annually (UNEP, 2010). According to a report by UNEP (2005), the volume of e-waste constitutes 1 percent of solid waste on average and is expected to increase to 2 percent by 2010 in developed countries. Only in the US, more than 100 million computers, monitors and TVs are discarded and 125-130 million cell phones become obsolete every year (Government Accountability Office, 2005).

This problem is directly related to the growth of the electronics production and consumption. Reports show that electronics industry grows the fastest among the other manufacturing industries (Grossman, 2006). Specifically the production rates of the ICT are rapidly increasing. For instance, according to Forrester Research (2007), the number of PCs worldwide will increase to 2 billion by 2015, with more than 1 billion in use by the end of 2008.

[3] Electronic equipment is defined as equipment which is dependent on electric currents and electromagnetic fields in order to work properly (EU, 2003).

[4] Information and Communication Technologies (ICT) can be defined as information handling tools: a varied set of goods, applications and services that are used to produce, store, process, distribute and exchange information (UNDP, 2001). Among all the possible products that can be included within ICT, computers, the mobile phone and the Internet play central roles (Toyama, 2008).

Figure 1: Historical PC penetration rates in seven regions between 1980-2005 (Source: Yu et al., 2010).



E-waste can be repaired/refurbished for re-use, recycled, incinerated (particularly the plastic parts) or land-filled. US is the world champion in land filling and incineration of e-waste (in 2007, only 13.6% of annual e-waste was recycled), with China following. (Zoeteman et al, 2010). The growing amount of e-waste brings serious concerns about especially landfill spaces in developed countries. For instance, as of 2007 it was reported that the landfill spaces in Japan were expiring as a result of the very large manufacturing base Japan has and its limited natural disposal chances (ElCINA, 2007). Clapp (2002a) asserts that most of the *waste-sink capacity*[5] in rich, industrial countries has been depleted already and fewer landfills are available in countries like the US and Japan. As the societies of developed countries have become more aware of the ecological impacts of waste disposal areas, communities are not as willing as before to accept landfill areas within their regions.

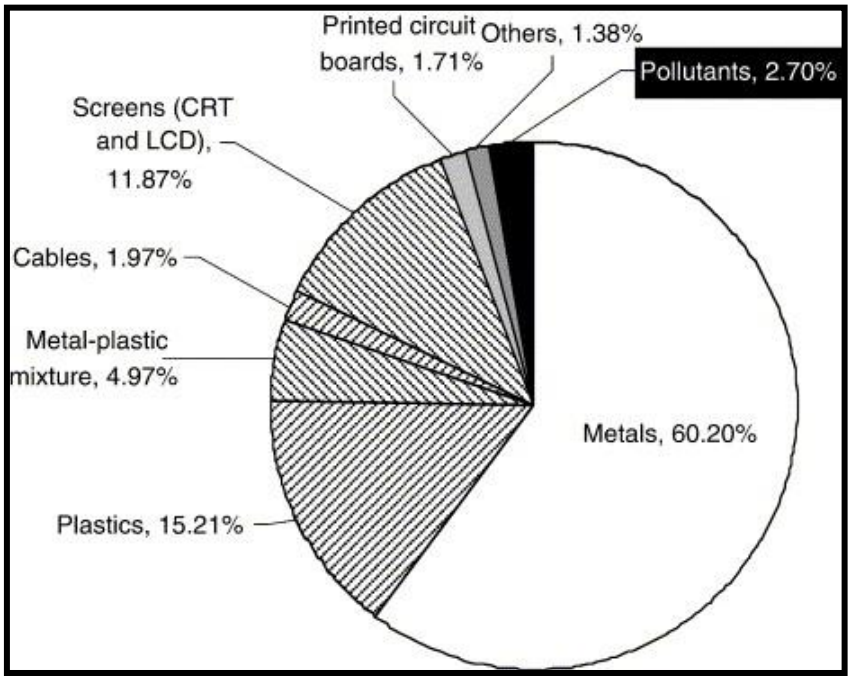
On the other hand, many reports emphasize the difficulty of making a sound analysis of the current status and future of the volume problem, because gathering sound statistical information about the amount of e-waste emerging world-wide is a very complicated task. To understand the rate of growth of e-waste, analysts mostly use the growth of production of new electronic products. It is assumed that the disposal of old products will be driven by the production of new products (Williams, 2005). However, the heterogeneity of country specific markets for different electronic goods as well as the global improvements in specific electronic equipment makes it hard to do sound forecasts. For instance, while the growth of e-waste from refrigerators can be calculated easily (since the refrigerator markets are in general saturated) it is difficult to say the same for cell-phone e-wastes. Also, it is known that the purchase of new electronics does not necessarily mean the immediate disposal of the old one. People tend to keep and store their old/unused electronics for a while before they decide to throw them out (Huisman et al., 2012).

[5] Clapp (2002) defines the waste-sink capacity as "the capacity of the earth both environmentally and socially to absorb the growing amount of waste" (p.4)

Health and Environmental Damages

The second problem associated with e-waste is the health and environmental damages of e-waste. Almost all electronic equipment includes various types of harmful materials that can create high risks on human health and can lead to environmental degradation. Materials like lead, mercury and cadmium are used for the manufacture of electronic goods, which comprise 2.5% of the material in the e-waste stream and are known to have adverse impacts on human health (from brain damage to kidney diseases, cancers) and environment once released into the environment. About 70% of the metals mercury and cadmium in US landfills is from e-waste. Also, about 40% of the lead in landfills comes from consumer electronics (Hilty et al., 2006). These materials are not easily separated and if they are recycled with improper methods, "unacceptably high" amounts of these toxic compounds are released (Mulvihill et al., 2011, p.284).

Figure 2: Material Fractions in e-Waste (Source: Empa, 2005).



The toxic risks related to these hazardous materials can occur during the entire life cycle[6] of electronic products, starting from the manufacturing process until disposal or recycling (Brigden et al., 2007). However, unlike many waste types, the major environmental effect of e-waste arises as a result of improper ways of disposal or recycling (Liu et al, 2009). Studies show that there is a high possibility that toxic materials emerging during inappropriate e-waste handling can spread to workplace environments, the atmosphere, surrounding lands and to sewer systems. For example, an inquiry of the Basel Action Network (BAN) (2002) found that a water sample collected from the river near e-waste open processing sites contained lead which is 190 times over the amount determined by the World Health Authority Organization (WHO) as acceptable. A study by Yu et al. (2006) has shown that the soil around the e-waste recycling areas in Guiyu contains high amounts of Polycyclic Aromatic Hydrocarbons (PAHs), which is a persistent toxic substance. The authors claim that the high

[6] Life cycle of a product is defined as all phases in the life of a product, from its conception to final disposal. "Life-cycle thinking from an environmental perspective considers the sequence of raw materials extraction, manufacturing, distribution, use, and disposal." (Cooper, 2005, p.55).

amounts of PAHs emerge due to the primitive, open burning of the plastic parts from e-waste. Because they are resistant to biodegradation and can aggregate through the food chain, PAHs in the environment mean a long-term threat to human health. Moreover, concentration of heavy metals and persistent organic pollutants discovered in the air of Guiyu is much higher compared to other cities, which indicates highly possible health risks the workers and the inhabitants of the region might be facing through inhalation and dermal exposure (Wong et al., 2007).

Photo 1: Burning of cables in a metal scrap yard in Accra, Ghana (Source: Öko Institut, 2010).

In most of the informal e-waste disposal and recycling centers in developing countries, the waste is processed in the "backyards", with very primitive methods. Wires are burned in huge piles to recover the copper inside them. Circuit boards are melted in open acid baths to extract the precious metals and most of the time people working without any protective masks are exposed to the dangerous gases released during this process. The plastic left out after the "recovery" of the metals is most of the time burned in open air, exposing the whole neighborhood and the habitants to the dangerous materials released during and after the fire (Wong et al., 2007; Yu et al., 2006; Wong et al., 2006)[7]. In spite of the recent increase in the media attention to e-waste and related issues and academic studies showing the environmental contamination around the primitive e-waste processing areas, public awareness about the environmental and health related damages of e-waste is almost "nonexistent" in these e-waste recipient regions (Liu et al, 2009).

[7] http://youtu.be/ZHTWRYXy2gE A short documentary by Journeyman Pictures shows the e-waste processing in China explicitly. Retrieved on 28 June 2011.

Photo 2: Extraction of copper from printed wiring boards (PWBs): (1) manually removing varnish, (2) recovering copper-sulphate after submerging PWBs for 12 h into sulphuric acid by boiling off H2O using PWB residues as a fuel, (3) manually segregating the copper layer and glass fibres after burning multi-layer PWBs (as they are resistant to the acid), (4) scrap iron is added to the remaining liquid to react with the dissolved copper, (5) fallen out copper slime is a third product bringing the total to 1–2 t of copper per month, (6) such an enterprise creates about 12 jobs, however at high-external costs**. (Source: Widmer et al., 2005).**

Trans-boundary movement of E-waste

Considering only the volume and environmental & health aspects of e-waste, the matter might appear mostly like a local problem, which countries need to tackle individually for their own lands and public. However, through globalization, e-waste problem (similar to other wastes) has encountered another dimension. The third problem combined with the first two, transforms e-waste into an international issue: e-waste as well as second hand usable electronic equipment, is traded internationally for reuse, recycling and disposal purposes, mostly to developing countries. It is predicted that about 50 to 80% of the e-waste collected for recycling in industrialized countries end up in recycling centers in Asia (China, India, Pakistan, Vietnam, the Philippines, etc.) and in Africa (Ghana, Nigeria, etc.) (UNEP, 2005). In addition, by this way the environmental impacts associated with e-waste are also being externalized to the countries which are vulnerable to these transfers because these countries mostly lack certain protective rules and regulations or the good governance to implement rules (Gibbs et al., 2010).

Trans-boundary traffic of e-waste creates economic benefits particularly in the short term for both sides of the traffic, which has been until recently the basic reason behind the general reluctant attitude of the developed and developing countries towards banning the trade of e-waste completely. Developed countries can save from disposal and recycling costs which are high due to their strict environmental regulations and high labor costs, and poor countries benefit new economic activities

and revenues that come with the e-waste imports (Liddick, 2010). Short-term gains and the overemphasis of profit maximization highlight the economic benefits and overshadow the social, environmental and health-related costs. As a result, the dynamics of the free market make the e-waste trade a profitable business for some actors, especially under uncontrolled circumstances and loose legal schemes.

Figure 3: E-waste routes and recycling sites in Asia (Source: UNEP, 2005).

The main problem with the trans-boundary movement of e-waste is that, most of the waste reaching the current destination countries are handled by the informal sector, which does not possess environmentally sound and safe waste processing capabilities. In addition, research shows that it is also possible to see formal sector companies in cooperation with informal actors because of the lower transaction costs. This is the case especially in India, as various journalist reports indicate.[8] Consequently, increasing amounts of e-waste is "processed" under unhealthy and unsafe conditions, which creates great risks for a wide range of people including the manual recycling workers and the people living close to these worksites, and the nature around them. Moreover, the economic benefits of e-waste trade are not distributed equally: While manual workers can make around 1-3 dollar per day for instance in India (Mundada et al., 2004) bearing the health damaging effects of working with e-waste under primitive conditions, the "bigger players" in the traffic make the big profits. It is reported that the income especially the manual dismantling/recycling workers, who are described to be at the "lowest level of the e-waste trade chain", earn through the e-waste business in India is not

[8] http://www.time.com/time/world/article/0,8599,2071920,00.html News article by Nilanjana Bhowmick, published on Monday May 23, 2011.

even enough to take them out of the poverty line (Mundada et al., 2004). The traders that send big chunks of e-waste through ships from the developed countries, the people in the developing countries who buy these e-wastes through auctions and the manual dismantling shop owners are counted as some of the big players of the e-waste trade.[9] Figure 4 shows an indication of the wages e-waste workers make in Ghana, observed through a study by the Oko-Institut in 2010.

Figure 4: Remuneration (in US$) for the people engaged in refurbishing and e-waste recycling business in Ghana (Source: Oko-Institut, 2010).

	Refurbishers	**Collectors**	**Recyclers**
Remuneration per day (in US$)	6.3-8.3	2.3-4.6	5.8-9.5
Remunaration per mornth (in US$)	190-250	70-140	175-285

At the moment, there are many countries that have banned imports and exports of toxic waste through their national laws (for instance China, one of the biggest receivers of e-waste has actually banned toxic waste imports in 2000 (Hicksa et al., 2005). However, there is no global consensus on completely stopping the trans-boundary movement of e-waste. The most important international regulation on e-waste trade is the Basel Convention, which was signed in 1989. The agreement does not ban international e-waste transports, but rather intends to implement a control mechanism on them. For instance, exports are permitted if the recipient country handles the waste in an environmentally sound management (ESM). Or, if the recipient country has banned any import of toxic waste, then countries that have ratified the Convention cannot export their waste to these countries. But US, as one of the biggest producers of e-waste has not ratified the Convention, therefore the US e-waste exporters are not legally bound by the Convention. Consequently, exports that leave the US ports under domestic legal permissions actually can create illegal traffic for others.

Later, an amendment to the convention that bans the exports of e-waste (with all other hazardous waste) from OECD to all non-OECD countries has been proposed in 1995. This amendment is legally binding, and proposes to bring criminal penalties to the violators. However, the amendment has not entered into force yet, and countries like the US, Australia, Canada, Japan and South Korea, which have not ratified the amendment, are known to form a struggle against the entry of the ban into force (BAN, 2011).

In spite of the existing regulations, trans-boundary movement of e-waste still continues. It is estimated that 54 percent of the e-waste produced annually in the EU is exported outside of the Union, most probably to Africa and China, although the EU has banned these exports (European Commission, 2008c). The lack of standardization in e-waste descriptions and classifications is addressed as another crucial factor that increases the likelihood of illegal international activities with e-waste, even under strict legal schemes that ban them. Since separate trade categories for e-waste, e-waste types and used electronics in working conditions do not exist, e-waste can often be exported under second-hand usable electronic equipment, which is legal trade material according to the Basel Convention.[10] The physical nature of waste in general is another factor that increases the difficulty of controlling illicit traffics (Liddick, 2010). The "low integrity level" of waste makes it easy to modify the physical appearance of waste for deceptive purposes. My personal conversations with the e-waste

[9] Ibid.
[10] http://www.nytimes.com/2009/09/27/science/earth/27waste.html?pagewanted=all Retrieved on 17 June 2011.

experts[11] have shown that this is also very much valid for e-waste. The large legal trade in some types of e-waste (such as scrap metals) makes it possible to hide the illegal types of waste within the legal materials. In some cases the illegal e-waste is hidden within other types of legal trade materials. For instance, one of the experts that I have interviewed have told me that some containers, which are supposed to be filled with second hand cars, can later appear to be carrying old electronic equipment as well, lurked inside the cars.

The lure proposed by this "industry" has taken the attention of formal actors within the e-waste chain as well. This situation makes it more difficult for researchers to gather sound information. The informal actors are already not willing to share information: From the bigger actors who manage the transports to the manual labor working for dismantling, the participants of the informal e-waste flows do not want to open their doors because they are afraid to lose what they have. During a conversation with one of the consultants of the FFact[12], a company which participates within the Dutch WEE Flows Research Group[13], I was told that even the e-waste recyclers and refurbishers who claimed to have only legal activities would not like to take the attention of the universities and academic scholars to the e-waste related issues. As she has told, this could mean too much interference to their business, which could spoil the way they have been doing their activities until so far. That is why; as a master's student, I was rejected to join to the interviews that the consultant would make with the refurbishers and possibly with the traders. This does not come to surprise, as a 2007 report of the Dutch Ministry VROM has found out that 28% of formal e-waste businesses (collectors and exporters) were exporting e-waste illegally from the Netherlands.(European Commission, 2010a). According to scholars, the boundaries between legal and illegal activities have become so blurry in the case of e-waste that even the formal, legal actors are not very sure about the legitimacy of their business activities. Consequently trans-boundary movement of e-waste has been operating in some sort of "zones of ambiguity" as described by Hornsby (2007), which increases the lure of the issue for various actors.

[11] I have conducted semi-formal interviews with 3 consultants of the Dutch WEE Flows Research Group in February-March 2011. For more information on the Dutch WEE Flows Research, please check (Huisman et al., 2012).

[12] www.ffact.nl

[13] http://www.vie.unu.edu/article/read/e-waste-flows-we-buy-more-lighter-and-short-lived-products Retrieved on 1 April 2012.

3. A More Conclusive Approach: The Origins of the Problem

The e-waste problem shows its damage on local level, which takes attention to issues related to the problem at local level and misdirects the solution approaches only towards the local aspects. That is why the related literature has numerous studies on evaluation of e-waste management systems in for instance China, Nigeria or India; and their comparisons with better working examples from the developed countries (Khetriwal et al, 2005; Nnorom and Osibanjo, 2008; Yu et al., 2010). Most of the time the conclusions propose that if developing world can learn from the experiences of developed countries, understand how their waste management systems work and implement their better technologies, the e-waste problem is solved.

Although the symptoms of the problem are seen at local level, e-waste is in essence a global issue; very similar to most of the sustainability related problems, since "the production, consumption and related policy decisions in any geographic locale have the potential to create unseen unsustainable burdens on productive ecosystems in other regions" (Kissinger et al., 2011, p.2011). Moreover, it is a problem at systemic level. The way the current techno-economic system based on capitalist economy operates in the global level is failing in certain aspects that create damages at local level. This is a crucial point to realize for a realistic evaluation of the e-waste problem. Alienating the failures of the system that create the damages, and focusing only on regional and domestic symptoms can bring short-term improvements at regional level but may not create long-term success at global level. More importantly, as long as the system continues to operate the way it did, the damage will find new locations at different parts of the world. That is why it is critical that particularly the policy actors, who are responsible to develop global solutions, can acknowledge that the wrongdoings emerge, and are sustained as a result of the way the system works.

I believe that the scope of the disciplinary angles that have been explained in **Section 2.1** shows that implementation of one basic approach can cover only a partial aspect of the complete e-waste story and therefore can bring limited understanding. The problem has been handled with a single dimensional perspective on how to manage the increasing amounts of e-waste produced and increasing flows of e-waste through international borders. Ecological concerns, fighting with crime, international and environmental justice problems, economic growth and sustainability have been the emerging priorities among these studies. However, the efforts have been almost in all cases focused on *how to manage the problem*; without a careful and detailed analysis of the *emergence of the problem*, from the deepest roots. I suspect that the proposals given through these partial management solutions may be missing the multi-dimensional nature of the e-waste problem. By doing so, in the worst case, they may even worsen the symptoms of the problem. In this chapter, I investigate whether this is the case.

In the following sections I explain the more hidden structural mechanisms that create and continue the e-waste problem. For this aim, I follow this methodology: I conduct a systemic overview of the critical arguments about sustainability policies in general, and their implications on the e-waste problem in specific. This systemic overview assists me to construct the backbone of my critical analysis and argumentation of the e-waste problem and its root causes. Later in **Chapter 4,** I use this backbone to implement a critical discourse analysis of the important policy actors.

Briefly, in this chapter I argue that three paradigms, inherent in the current techno-economic system based on capitalistic way of thinking, create the e-waste problem. These paradigms complement and support the status-quo of each other, thus they need to be addressed all together to understand how they co-create the contemporary e-waste problem with all its aspects and dominate the policy responses. Unless these paradigms and the consequences of their dominance are discussed,

the efforts to solve the problem may bring local reliefs but new damages will emerge in different parts of the world. These paradigms are:

1. Consumption (of electronics as well) is the engine of perpetual economic growth and development.

2. Environmental problems emerging in the system (including the e-waste problem) are production related problems and they can be solved with "more and better production" (Princen, 2002, p.25)

3. Free trade (of e-waste as an economic value) is necessary for a better-working global economy.

The current techno-economic system is based on ever increasing production and consumption of goods and services. The indicators of improvement and development − *economic growth* − have a focus on the change in the amounts of production and consumption. The focal point of the system is production and economic expansion through production. It takes the current growth definition and the related resource use style as given and necessary for better economy. The free trade paradigm supports the expansionist approach of the system and makes it possible to produce more with less cost. In the context of the e-waste issue, minimization of electronics consumption cannot be easily discussed because that would contradict the consumption based paradigm. By this way the volume aspect of the problem, which is directly related to the over-consumption of electronics, is ignored. With the influence of the production based paradigm, e-waste problem transforms into solely a production related problem, and the main quest is to manage the increasing amounts of e-waste, to find cheaper alternatives to make use of them and develop better technologies to recycle them. Free trade based paradigm assists the dominance of first two paradigms, by providing lower-cost alternatives in different parts of the world for production based solutions, and by guaranteeing that the pressures emerging in over-consumptive societies are released.

In the following sections of Chapter 3, firstly I will explain in more detail the basic elements of these three paradigms and the critical arguments against them. In addition, I will analyze how these paradigms operate in the e-waste specific context.

3.1. Unquestioned Consumption

Sustainability related problems have been attracting more and more attention from researchers, as a result of the drastic changes ecosystems have faced in the last fifty years. According to Millennium Ecosystem Assessment report, over the past 50 years, humans have changed ecosystems faster and more drastically than in any comparable period of time in human history. (Millennium Ecosystem Assessment, 2005). The environmental crises that emerge as the symptoms of these problems rise concerns about the impacts of the modern societies on the environment and the sustainability of the resources of the Earth. These concerns have led to calls for fundamental changes in life styles and consumption patterns of modern societies.

Nevertheless, concern with resource consumption is hardly a new topic. Jackson (2006) traces the origins of debates about the consumption of resources to at least the second or third century BC. The early modern critics of over-consumption emerge around mid-19th century with prominent names such as Henry Thoreau and Willem Morris. The issue was placed as a solid discussion first time at the United Nations Conference on the Human Environment in Stockholm in 1972. Especially the late 1990s have witnessed rapid increase in the discussions about over-consumption at policy level, under the new term *sustainable consumption* that emerged from the Rio Earth Summit in 1992. The most concrete initiative at policy level is the launching of Sustainable Consumption Network (SC.net) by

the United Nations Environment Program (UNEP). This network has since been providing vast amount of information on policy initiatives in sustainable consumption and production and enabled UNEP to become the lead agency in the area along with United Nations Department of Economic and Social Affairs (UNDESA). However these debates revolve especially around issues like energy and water consumption. Over-consumption of goods, such as electronic goods etc., is hardly discussed within the sustainable consumption context. In addition, these debates have focused on new technology and efficient production as the key mechanism for change towards sustainability. So, developing new technologies that are more resource efficient and promoting the adoption (consumption) of these new technologies by (modern) societies has been the center of attention from policy, as well as the academic circle. Discussions about decreasing the consumption itself could hardly reach to the mainstream level.

According to Spaargaren (2011), neglect of the consumption stage in sustainability related problems is a crucial mistake that has been done involuntarily for some time in the academic literature Although technology and production oriented angle has been the dominant approach towards sustainability related problems and environmental governance, there have been attempts in the literature which have a quest to understand consumption, but only at the level of the individual. These attempts have been related to human psychology and behavior and came from economists and socio-psychologists. According to this approach, environmental change is determined through the change in human behavior of individuals, who are the key units of analysis and policy. The goal is to lead end users/ consumers through information provision to behave less consumptive particularly by using green products. This unilateral analysis of consumption leads to a concentrated focus on the consumer and her individual choices. The role of producers and businesses with shaping consumption patterns of people to satisfy their interests is not paid enough attention (Sanne, 2002). More importantly, this approach "neglects the role of the state and how business tends to co-operate with or pressure governments to create conducive conditions for increasing consumption" (Sanne, 2002, p.273).

What/How is Sustainable Consumption?

In general deciding on what is a need and choosing to meet that need through purchased choices or not; or deciding to choose an alternative which has the least environmental impact or choosing a less consumptive way to satisfy the need are the points that need to be discussed while analyzing sustainable consumption. (Princen, 2006).

Although the unsustainability of existing patterns of consumption is widely recognized at policy and scholarly level, what sustainable consumption exactly should be has a variety of answers adopted by different actors/ institutions. One of the most significant differences between these definitions lies in the extent to which sustainable consumption involves changes in consumer behavior and lifestyles. Based on this, there are two groups of approach: The first approach defends that sustainable consumption is consuming more responsibly, or simply, less. According to this angle, consumers need to take into account environmental constraints while determining their consumption needs. The second approach, very much related to the second paradigm (**Section 3.2.**) defends that sustainable consumption does not necessarily mean consuming less and can be achieved through consuming more efficiently. According to this approach the domain of interest is production processes because sustainable consumption implies consumption of more sustainable products and these products can be produced through more efficient production processes (Jackson, 2006).

The second definition has been embraced widely in the literature and particularly in policy discussions, which brings a concentrated focus on technological improvement and the provision of more efficient products, services and infrastructures without enough criticism on the increasing consumption patterns. However, as it will be explained in more detail in **Section 3.2**., this view most

of the time leads to a type of sustainable consumption that implies "(more) consumption of more sustainable products" (Jackson, 2006, p.4). As a result of this approach, "it would be entirely possible to have a growing number of ethical and green consumers buying more and more sustainable products produced by increasingly efficient production processes, and yet for the absolute scale of resource consumption − and the associated environmental impacts − to continue to grow" (Jackson, 2006, p.6). In addition as historical evidence displays, improvements in resource productivity have generally been shadowed by increases in scale of consumption. Therefore it is not always and directly possible to reduce material consumption while maintaining the amount of goods and resources that people buy (economic consumption), because the latter most of the time depends on the consumption of material resources by nature (Jackson, 2006).

The Black Box: Sovereignty of Consumption

Sustainability problems related to resource intensive consumption necessitate deeper debates about consumption, consumer behavior and consumerism. However, consumption, accepted as the engine of economic growth, is most of the time treated as a passive process, which is predominantly effected by the individual's own nature. As a result of this understanding, to question the very nature of consumption and the contemporary consumption patterns of societies is challenging particularly at the policy level. One of the basic reasons why some reject the definition of consuming less for sustainable consumption is that it can mean the discussion of difficult issues such as consumer behavior and lifestyles. They are difficult to discuss particularly because they are among the fundamental assumptions about the dynamics of modern society and economy. As Jackson (2006) explains, "intervening in consumer behavior would contradict the much-vaunted sovereignty of consumer choice. Reducing consumption appears to threaten a variety of vested interests and undermine key structural role that consumption plays in economic growth" (p.6).

On the other hand, this approach draws a picture of the consumer as if s/he is always 'really intent and keen on consuming' and because of that 'the environmentally required reductions or charges are unrealistic' (Sanne, 2002, p.273). Consumer choices are affected by various dynamics, including structural factors of societies as well as societal dynamics "such as working life conditions, urban structure and everyday life patterns." (Sanne, 2002, p.273). However, the avoidance of discussing the very nature of consumption obscures how these dynamics also have a role in shaping consumption. For instance, according to some researchers like Elizabeth Shove, it is the daily domestic consumption and social practices, which start to define what should be accepted as "normal ways of living", normalizing the nature of the social practices and the consumption levels even if they are environmentally not sustainable. Consumption and practices place themselves into daily routines and habits (Shove, 2003, p.400). By this way, new patterns emerge and become normal, although they might be having significant consequences for sustainability (Shove, 2003).

Consumption Based Growth and Its Consequences

According to the dominant economic thinking, consumption plays the major role of providing for individual and collective well-being. From this perspective, the national income − GDP (Gross Domestic Product) − can be accepted as a proxy for the well-being we obtain from consumption. In the Western countries, national income has been rising during the last 60 years (World Resources Institute, 2000). According to the advocates of consumption, this is a sign that increasing consumption rates have been the main driving force of improving living standards and human well-being in the Western economies over the last 60 years (Jackson, 2006). However this approach does not really take into account the effect of the natural resources that decrease as a result of increasing consumption on

economic progress. Moreover, environmental and social damages caused by the increasing rates of consumption and their impact on long term economic development are overshadowed through this approach. That is why, as Princen (2006) states, "economic growth, conventionally defined and measured, can be 'uneconomic', even on its own terms, let alone on ecological terms. It can lead to net harm, especially when ecosystem services, family and community integrity, and future generations are taken into account."(p.60).

Most importantly, the main assumption of the conventional economics, that human well-being increases with higher consumption rates, is challenged with empirical studies on the so called *life satisfaction paradox.* According to the prominent study contemplated by Inglehart & Klingemann (2000), higher income, economic growth and thus higher consumption rates do not necessarily increase the satisfaction people take from life, especially if the average national income of the country is relatively high compared to poor, developing countries. For instance, "measured in constant dollars, the world's people have consumed as many goods and services since 1950 as all previous generations put together. Since 1940, Americans alone have used up as large a share of the earth's mineral resources as did everyone before them combined." (Durning, 2006, p. 129). On the other hand, according to the surveys of the National Opinion Center of the University of Chicago, "no more Americans report that they are very happy than in 1957. The very happy share of the population has fluctuated around one-third since the mid-1950s, despite near-doublings in both gross national product and personal consumption expenditures per capita' (Durning, 2006, p.130).

Therefore, data suggests that maybe at lower income levels increasing national income is correlated with happiness and life satisfaction; but after a certain level, the correlation does not exist anymore. Consequently, higher income and higher chances of consumptive capability might be improving the well-being until a certain level of income is achieved; nevertheless this does not mean that limitless consumption is a must for human well-being. Based on this information, it is inevitable but not to agree with the comments of Jackson (2006): "We might perhaps be tempted to put up with a little environmental degradation if it was the only way of increasing human well-being. But damaging the environment and at the same time failing to deliver consistent improvements in well-being is potentially tragic. Consumer society, in this view, appears to be in the grip of a kind of social pathology." (p.11). As Princen(2006) suggests, maybe we should go back to " the origins of, the neo-classical economic model and (ask) what model would have been most useful given ecological constraint, given the lack of unending frontiers and infinite waste sinks and given the inability to find a technical substitute for everything from petroleum to the ozone layer" (p. 63). Or, we should redefine **"**economic growth in terms of individual welfare of a less material dominated kind" (Sanne, 2002, p.286).

Understanding Consumption from Innovation Sciences Angle

There are various explanations in the literature from distinct academic disciplines about the drives of consumption and the dynamics shaping consumer behavior. Since this is not a study on understanding consumption in general, I will not go to any further detail with these theories. Nevertheless, the arguments related to Innovation Sciences discipline, more precisely the studies on Sustainability Transitions need special attention within the scope of this study.

Transition Studies within Innovation Sciences, has the quest to analyze and understand the emergence, transformation and the atrophy of socio-technical systems. Most of the Transition Studies literature use the multi-level model developed by Rip and Kemp (1998) to understand the processes that take place between the three layers of socio-technical systems during socio-technological changes. These three layers are socio-technical landscape at the macro level, regimes at the meso level and niches at the micro level. The key idea is to observe and understand how new technologies

emerge within niches in smaller scales and later become successful and reach more users and acceptability; and possibly modify the pre-existing regimes and become mainstream. The research framework of Transition Studies has most of the time been implemented on innovations. The goal of research has been to understand how new technologies find the initial space for themselves, and by time become working configurations and rise to the power and popularity to shape and re-shape regimes and even landscapes. Studies on sustainability related problems have adopted this research lens to understand how innovative technologies for sustainability purposes could get firmly established within the regimes that *somehow* created or contributed to sustainability problems we are facing.

However, the emphasis on innovation can contribute to a single sided understanding of sustainability; that it is only "a matter of resource management, efficiency and ecological modernization" (Shove & Walker, 2007, p.7). Majority of the research done within the Innovation Sciences field have followed this techno-centric approach, which can fail to engage with bigger questions tracking the roots of sustainability problems. While analyzing socio-technical change, the main focus of these studies is on how some technological solutions have become successful (become popular and widely used by people), while others have disappeared. However, most of the time fundamental questions about consumption (may it be energy, water or materials) such as for what the consumed materials are used for, how the practices that depend on this consumption evolve, can be overlooked because scholars are concentrated on understanding the success or failure of new technology and services.

As an alternative towards the technology centered angle of the (Sustainability) Transitions Studies, Shove (2010) proposes to pay more attention to the patterns of demand and habits, practices of everyday life, and politics shaping this demand to understand the socio-technical transitions toward sustainability better. Although transition studies have largely neglected, understanding how resource intensive trends have become "normal" among wider populations, is at least as important as dealing with the design of more efficient systems of provision. As Spaargaren (2011) states, "People do not develop ideas and ways of doing 'from within' by themselves. Their thinking and doing are shaped by fellow citizens and by objects and situational factors which form an integral part of the contexts of their behaviors" (p.814). Hence, ordinary, daily choices of consumption are shaped rather by habits, practices, norms about convenience; that is consumption behavior is influenced by wider chains of social and institutional interactions and norms (Shove, 2003). Some scholars call this notion "ordinary consumption", which can be described as the consumption which is not oriented specifically towards individual display, but rather is about "convenience, habit, practice and individual responses to social norms and institutional contexts over which the individual has little control'' (Jackson, 2006, p.112).

This approach rejects the so called *sovereignty of consumption* belief and shows that consumption may not always be shaped through individual ration, and most importantly, not necessarily to improve the well-being of consumers. Especially once the information about the life satisfaction paradox is combined with these arguments, it can be concluded that consumers do not consume only with the rational purpose to increase their well-being. There are all other motives and factors influencing the consumption patterns, and most of the time these dynamics are not coming from within the individual herself.

In addition to the social practices approach, there are other proposals in the Innovation Sciences and Socio-technical transitions literature for understanding the way consumption is shaped. Sanne (2002) takes attention to the role that surrounding circumstances such as urban structure, changes in the societal system, consumer culture and the increasing proportion of time work life takes from people play to create the incentives to consume. In some cases, these surrounding forces can even result with an inevitability to consume, which all create a "lock-in" situation for the consumers, where they are not necessarily willing to consume actually.

From an environmental policy perspective, this approach brings an important suggestion: because demand levels and consumption patterns are outcomes of not only technical systems but also socio-technical practices, and since technical systems and socio-technical practices are interdependent, "there are multiple possible points of intervention and environmental innovation (…) policy makers can intervene with respect to modes of production, provision, access and use. Critical intervention at any one point in this integrated system is likely to influence the operation of the whole."(Shove, 2005, p.1055).

Electronics Industry and Consumption

The air conditioning patterns show a striking example of how practices change in such unsustainable ways but because they are accepted as standard and normal, it becomes difficult to question the social practice itself rather than developing a technology that will ease the outcome of this practice (Shove, 2003, 2004). Especially in the developed and richer parts of the world, keeping indoor environments at 21-22 degrees C have become an unquestioned, normal habit and the temperature is kept constant during the whole year no matter which season is lived. A more interesting observation by Shove (2012) is that these patterns are not only limited to the Western countries anymore and they are spreading across the globe, to even not much anticipated locations, where it would not really be convenient to spend that much energy to keep the indoor temperature at those normalized levels. Thus, consumption patterns and practices are becoming more and more globalized; therefore there is a need and necessity for a post-national perspective for the analysis of unsustainable consumption patterns (Spaargaren, 2011). Summarizing the complexity of the situation, Shove (2012) states,

> "Such resource intensive interpretations, developed during an era of energy-plenty, have come to represent seemingly natural and therefore non-negotiable conditions that simply must be met− but also cannot be met, not on a global scale, in any sustainable fashion. In practical and political terms, any really significant reduction in energy consumption, and hence in related systems and infrastructures of supply will require a comparably significant revision of comfort regimes" (p.65).

Thinking in globalization terms, consumption of electronic goods can be one of the most suitable fields for a post-national approach for understanding the dynamics shaping demand and consumption. So what are the reasons behind the rapid increase of electronic consumption and the consequent e-waste amounts? The ICT field, its development, roles and status in the global economy needs special attention to be able to answer this question.

First of all, transforming into a knowledge economy has been promoted heavily as the new gate towards economic growth in the recent era. It has been emphasized by various institutions, governments and business leaders that if countries want to have the chance to catch up with the rapidly changing dynamics of the world and globalization process, they need to convert their economies to an Information Economy. This emphasis has led to more and more production and consumption especially in the ICT, which are the crucial tools of an Information Economy. Whether it is really necessary or not, whether it is really needed or not and the possible direct/indirect consequences of this much production have hardly been questioned; because attempting to question the ICT production and consumption rates would mean to be against the rapidly improving and increasing power of technology and the 'beyond doubt' benefits brought by the technology. As a result, like the other industries of the current economic system, which are especially led by corporate-dominated technological revolutions, the ICT industry has become increasingly consumption driven with the main target to maximize the throughput.

Secondly, one of the important facts that need to be recognized about electronics industry is that it is already one of the largest manufacturing industries of the world economy, but somehow this fact is obscured with a relatively different representation of the sector. Particular focus on service, science and software distracts the attention of the public from the social, political and environmental impacts of the electronics production, and creates the prevailing view of electronics as high-tech science and service-based industry (Lüthje, 2006). Nevertheless it has been realized recently that the production and consumption of electronic products is energy and material intensive (Lepawsky & Mcnabb, 2010; Cobbing, 2008). Especially when the ICT industry was first emerging, it was in general regarded as a clean and safe economic sector and this image was largely promoted by corporate and governmental actors. It was believed that the environmental impacts of ICT are much less than the environmental degradation caused by traditional industries such as energy and transport. Clean and lean environments, high-tech and science with full efficiency, high speed, have been the dominant images once electronics but especially ICT industry is the topic. The visions of improved technology opening wide the doors of the information age, closing the heavy-industry scenery of the Industrial Revolution and leaving its dirty relics such as grey smokestacks behind led to a widely believed notion for the electronics, that it is 'the clean industry' (Grossman, 2006). However, studies have revealed that the manufacture of ICT products necessitates large amounts of energy and water usage and releases toxic emissions (Cobbing, 2008). For instance, according to a consultancy report, the production and use of ICT is estimated to comprise two percent of global CO2 emissions, which is equal to the contribution of the global airline industry. [14]So e-waste is not the only problematic aspect of electronics industry related to over- consumption; energy and materials usage of the industry also needs to be addressed within the larger picture of criticism from a consumption angle perspective for future studies. As a result of these factors, electronics consumption particularly in the ICT field has grown rapidly; with more and more people owning more and more amount of electronics goods (increased ownership), which have to be renewed faster than ever before (planned obsolescence).

Increased Ownership

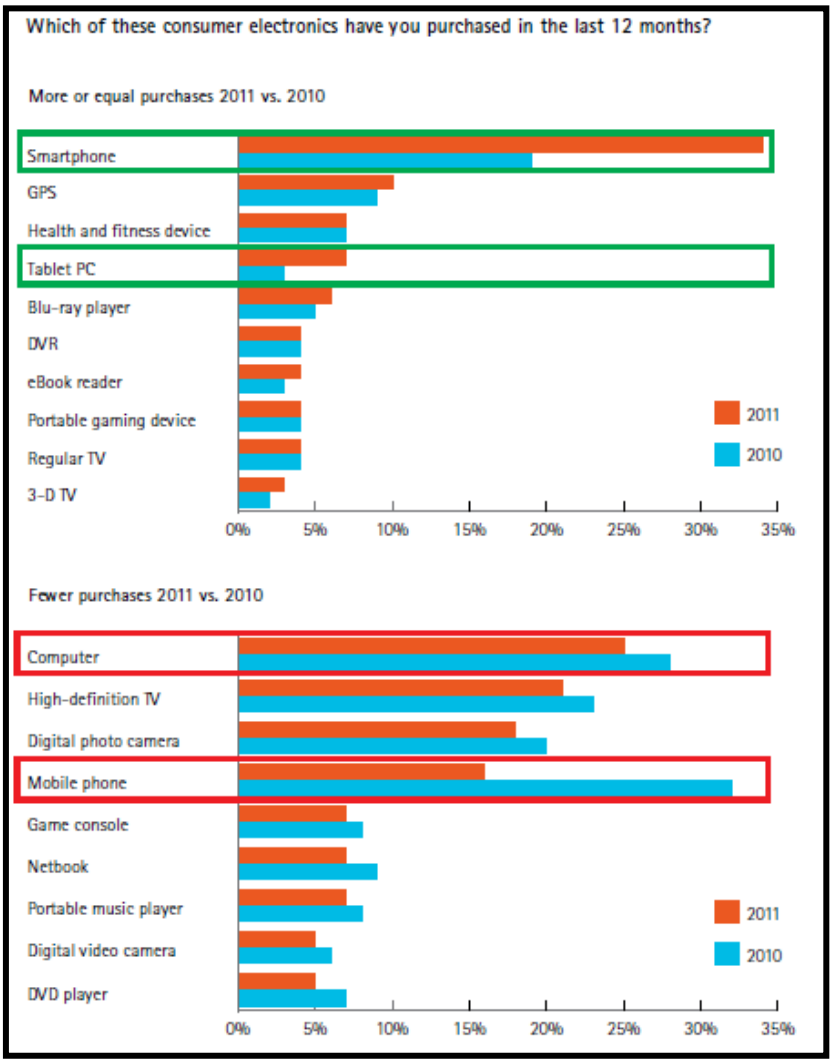
Progressive digitalization of all artifacts and lowering prices of electronics contribute to the increased ownership[15] of electronic goods. Ranging from washing machines to video cameras and TVs, significantly more households have more electronic products. Some of these products like mobile phones or TVs and their markets have saturated in many parts of the world, especially in developed countries; while newer technologies face great demand levels as they are presented in the market.

Statistics show that especially the recent popularity of mobile technologies has boosted the interest and purchase intention for mobile electronic devices, such as smart-phones, tablets and laptops (Accenture, 2012). Fuelled with this interest, new technologies and new versions of existing technologies are released every day and with relatively cheaper prices, resulting with rapid increase of the average number of electronic products owned by consumers. For instance, according to the Consumer Electronics Association, Americans own approximately 24 electronic products per household (Meryn, 2011). Especially recently, the driving force behind the increased ownership of electronic products seems to be rapidly increasing and spreading popularity of mobile technologies (Accenture, 2012).

[14] http://www.mckinseyquarterly.com/Information_Technology/Management/How_IT_can_cut_carbon_emissions_2221 Retrieved on 3 May 2012.

[15] Ownership can be defined as any one member of a household who owned a particular product or had access to a particular service.

Figure 5: Consumer Electronics Purchased in 2010 and 2011 (Source: Accenture, 2012).

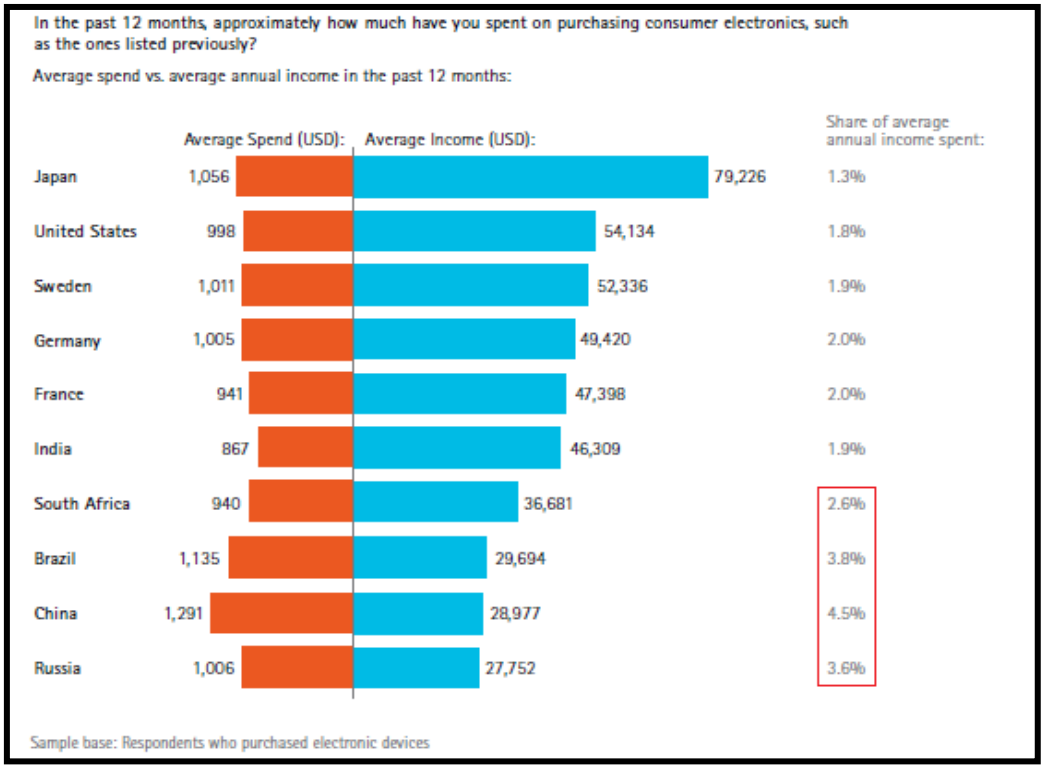


According to the Economist (2012), *hyper-connectivity* is one of the driving forces of the popularity of mobile technologies and their accelerating consumption rates. Being connected is highly addictive, and leadins people to stay online most of the time and be more inclined to purchase devices that will enable them to stay connected as easily as possible. The addicting nature of internet connection and its (possible) impact on consumption patterns of related electronic devices bring out an important contradiction to arguments defending the sovereignty of consumption, also in the electronics context. Studies reveal that it is not always the rational evaluations of the individual that lead to his/her consumption of electronic products, but irrational behavioral factors like addiction to technical devices like computers (Wieland, 2005), internet (Song et al., 2004), mobile phones (Park, 2005) or even addiction to certain brands like Apple (Skariachan, 2012); or the influence of their social environments (Kulviwat et al., 2009) can also direct them to purchase electronic products.

Although until recently a big proportion of the electronic waste production belonged to developed nations, statistics reveal the increasing demand in the emerging markets for electronic products, which leads to the significant growth of ownership in developing countries as well. According to a broad research contemplated by Accenture in 2012, consumers living in the in urban areas (except India) of the emerging markets have spent a greater percentage of their annual income in 2011 on consumer electronics than those in mature markets. In addition, according to the findings of

the same report, younger consumers (except in China) have spent a higher percentage of their income on consumer electronics in 2011than the spending of the older consumers. Moving from these results, the report concludes that the "love affection" of consumers for electronic devices will not disappear anytime soon. In contrast, "with mobility now the latest consumer technology darling, providers of related devices and content enjoy a booming market that shows no signs of slowing, at least in the foreseeable future."(Accenture, 2012, p.15).

Figure 6: Spending on Consumer Electronics (Source: Accenture, 2012).



Planned Obsolescence

One of the factors that have an important effect on the consumption patterns of electronic goods, especially ICT products and the consequent increase in e-waste amounts is the *planned obsolescence* phenomenon. Planned obsolescence, a term introduced by London (1932), is a fundamental tool of the conventional economics that makes sure that consumption will continue uninterruptedly, by intentional design and manufacturing of short-lived (unfashionable or no longer usable) products. This is done so that in future the consumer feels a need to purchase new products and services that the manufacturer brings out as replacements for the old ones. Planned obsolescence guarantees that competitiveness and technological development will work effectively in a free market and this will lead to improving goods and services (The Economist, 2009). That is why, from this perspective planned obsolescence is "the engine of technological progress and innovation" and the absence of it is blamed to slow down innovation pace (Fishman et al., 1993).

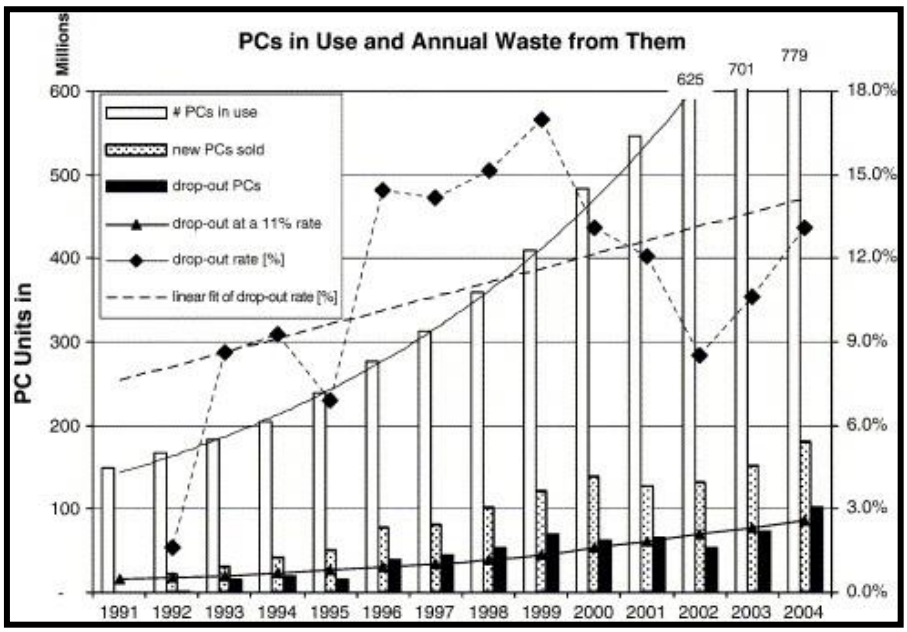
High rates of obsolescence is a typical business strategy widely used by the ICT industry to increase the throughput and therefore gain more capital from the high amounts of capital invested for the research and development of newer technologies (The Economist, 2009). By this way, the capitalistic circulation is accelerated. To achieve this circulation, the material quality of the products

is lowered. Simultaneously, purchase prices of consumer electronics have been decreasing as well, which leads to increased ownership. For instance, the number of days required to earn the cost of a television (based upon average gross weekly earning) has dropped from 44 in 1962 to 2.5 in 2000. For refrigerator, this transformation is from 57 to 5 (Data from Australian Bureau of Statistics, cited in Park, 2010). Although this may give the impression that more people who could not afford such electronic luxuries can now reach these goods and services, the cost impacts of shortening life spans are not only limited with lowering prices. According to Park (2010) "the ratio between cost of repair and cost of replacement has dramatically reversed in recent years" (p.81); so repair costs have become much higher. There are various empirical studies prove that this assertion is indeed true: for instance a study in Finland revealed that from 1981 to 1994 the price of new televisions increased by 20%, while the cost of repair work rose by over 150%. The findings for washing machines were 40% and 165%, respectively (Consumers International 1998, p. 20 as cited in Cooper, 2005, p.60). Scholars assert that, as a result of these developments, obsolescence rates of electronic products, particularly ICT devices, have become even higher and these devices have much shorter life spans. Figure 7 shows that global drop-out rate of PCs has risen, which indicates increasing obsolescence rates of computers.

In addition to the created need to replace the hardware, consumers are forced to upgrade their devices with newer software, which is often carefully designed to reduce the value and usability of the previous version. This is enabled by developing programs in such a way that the new versions can read all the files of the older versions, but not the other way around. "It is as if every generation of children came into the world speaking a completely different language from their parents. While they could understand their parents' language, their parents could not understand theirs."(The Economist,2009). By this way, higher obsolescence rates of the electronic goods are actually creating a 'locked-in' situation for the consumers (Sanne, 2002), where people have to change their products and buy particularly some of the electronic goods they use frequently because they get old and useless so fast. So, it is not always because consumers want to renew their products so often, but because they may be obliged to do so, they continue to consume with increasing rates.

Planned obsolescence does not only create a threat on sustainability through the increasing amounts of e-waste and the consequent damage of them on the environment, but also through uneconomically spent energy that was used for manufacturing of the products. For instance, studies show that the most energy-intensive parts of the computing industry are actually the manufacturing processes (Williams, 2004a). As products get shorter life-spans, the energy consumed for the manufacturing would hardly be compensated by the usability of the product because it is disposed too soon. More and more manufacturing of newer products will continue this uneconomic and definitely unsustainable consumption of energy, as well as material resources. Thus, lengthening the life-span of existing electronic products is the most environmentally friendly option not only for the minimization of the electronic waste but also for the minimization of the energy resources used for their production

Figure7: Trends of the PC market between 1991-2004. Increasing trend in drop-out rates of PCs reveals increasing obsolescence rates of PCs. (Source: Widmet et al., 2005).



Result: Wasting of Electronic Products Becomes Normalized

As a result of the decreasing expected life-spans of electronic products especially in the ICT sector, "consumer perceptions have shifted from seeing many of these products not as durables but as consumables'' (Park, 2010, p.80). With newer models of existing products and new product types, older electronics lose their usefulness much faster − useful in terms of compatibility with new software or the capability level of the product compared to newer ones. Also, because the prices of electronics are relatively cheaper, as the usefulness of products decrease, so does their value, particularly in consumptive, modern societies. Consequently getting rid of them becomes very much normalized especially for newer generations of these societies who are exposed to these consumption trends.

The dynamics of the current techno-economic system in modern societies transforms the disposal step into another mass "production process" and normalizes wasting as a chain within the whole system managing the throughput. Waste is collected from waste producers through mass disposal and waste management systems and taken "away" Clapp (2002a). The "away" phenomenon can be both a geographically and a mentally far away point; distant enough so that consumers living in modern societies do not see the direct ecological and social consequences of the waste they create anymore. Consequently, people have less and less understanding of the post consumptive consequences of the purchases they make, and they have even less realization of the waste that emerges during the production of the products they purchase. Since waste gets out of their sight very fast and easily, consumers tend to forget the possible damages (or even do not know anything about them) and assume that it is 'somebody else's' responsibility to consider these. This situation distances consumers mentally from the consequences of their consumption. As a result, the mass waste collection and disposal systems contribute to the informational darkness that consumers are under, distancing them both mentally and physically from their waste.

According to Clapp (2002a), garage is a twentieth century phenomenon, which was not faced by the older generations, because there was "so little of" the types of post-consumer waste that "cannot be re-used or composted" (p.7). The usage of synthetic materials, which do not decompose easily and fast, has increased significantly during the last 60 years as Clapp (2002) claims, and this contributes to the growing amount of industrial waste generated. With the increasing variety of products made from these materials which are not natural and difficult to decompose as in the case of e-waste, rise of a consumption culture, increased difficulty and price of the repairing of technological items, higher rate of obsolescence of ICT technologies and more widely usage of packaging have all contributed to the emergence of a "throw-away society" (Clapp, 2002a, p.7) particularly in the developed world.

Increased patterns of consumption and the consequent normalization of (electronic) waste in modern throw-away societies sharpen the distinction between valuable and valueless in terms of commodity and waste. Once a product is described to be useless and eligible for disposal, added with the complexity and high costs of repairing, it gains the 'waste' label quickly. Because the value of the product can be lost so fast, and it is not seen as a resource anymore but only useless and waste, working with waste or creating new valuables from waste becomes a dirty, condescended job, particularly in these societies. Waste is not perceived as a resource anymore that is why it is easily thrown away. As the personal observations of Reno (2009) shows, it is very difficult for those who "work with" waste and "give new value to waste through scavenging" to face the negativity attached to waste and making value out of waste, because it is "degrading and dirty, thus people would not do it unless they had to satisfy basic needs" (p.33).

On the other hand, meanings, value and level of usefulness attached to waste can depend on the dynamics of different societies and their different social structures. In various corners of the world that are 'away' from the modern, throw-away societies, the obsolete electronics which are not 'valuable and useful' for them anymore can regain value and transform into commodities. O'Brien (1999) calls waste a "bipolar object of political regulation and economic exchange" (p.271) because of the contrasting levels of value waste can carry through its life in different societies. That is why actually wasting is "a social process of value transformation" according to O'Brien (1999), instead of "a loss of value from objects" (p.271). Since wasting is an intermingled process of the social, economic and political dynamics, waste becomes an ambiguous term and object that represents different definitions for different actors and contexts: "a resource and not a resource, a potential value and a potential non-value simultaneously" (p.282). The existence of various dynamics and parameters involved with the definition of waste creates the "zone of ambiguity", which is vulnerable to be exploited by entrepreneurs who have illegitimate pursuits as well as the legitimate entrepreneurial purposes (Hornsby and Hobbs, 2007, p.564-566).

At this point, free trade and economic globalization serve to make sure that throw-away societies will be able to sustain their over consumption and consequent normalized wasting patterns as long as there are parties in different parts of the world who perceive e-waste as a valuable resource; an opportunity for cash inflow, or employment. That is why, e-waste and other types of waste as well, may continue to find for themselves routes to be taken 'away' even if very strict local regulations are in power. The lure is high enough for many people to ignore health and environmental threats on a personal level but also on societal levels. Depending on social, economic and political conditions, for many people e-waste is a good enough option for earning money compared to the non-existing alternatives. For others, it is costly and dirty; it is the unwanted side of technological development, knowledge economy and prosperity. As long as they are able to discard it without any cost or even some profit, they will continue to prefer dealing with e-waste in this way.

3.2. Production as the Only Solution

Majority of the e-waste policy studies in the literature have a focus on the basic question: how to improve the e-waste management system (of a specific region, country, etc.). Studies especially concerned with sustainable development argue about e-waste as a problem of inefficient production and evaluate whether and in what terms these inefficient ways of handling e-waste can be improved, by comparing them with the "well-working" versions in the Western, developed countries (Nnorom& Osinbanjo, 2008; Heart, 2007; Khetriwal et al., 2005). The notion of consumer sovereignty and that consumption is the basis of economic growth is integral to the production oriented paradigm[16], which sees production as the only solution for sustainability problems. Accordingly, techno-centric economic public policy can reverse the growing damage consumption leaves on Earth through new, efficient production methods. The efforts taking their roots from this paradigm are almost always on an institutional base, with focus on developing new proper technologies, infrastructures and products that citizen-consumers will hopefully adopt for the sake of sustainable behavior.

Production Oriented Policy Proposals for the E-waste Problem

In broad terms, the policy proposals in the literature on the e-waste problem which are dominated by the production-oriented paradigm can be divided into two groups, depending on the target of improvement that is proposed. Some policy proposals focus on the electronic products and suggest ways to improve the environmental efficiency of the products and the production methods as a solution to the e-waste problem. These policies will be evaluated in section 1. The rest of the policies argue that the failure of e-waste handling systems in specific countries are the basic reason for the emergence of the e-waste problem and they focus on ways to improve the e-waste management and handling systems under these local conditions. These proposals will be discussed in section 2.

1. More Environmentally-Efficient Products with Better Production

1.1. Improvement of Product Life-Cycles

One of the recent policy proposals on the e-waste problem is to promote the design of more 'sustainable' product life cycles. Accordingly, by decreasing the total amount of energy and materials used through the entire life cycle of a product, the overall environmental impact generated by the product, such as emissions, energy consumption and waste generation can be decreased. Since the focus is on the overall impact of the product through the whole life cycle, the trade-offs between different phases in the life cycle have to be taken into account. For instance, a product which is very easy to produce with minimum waste during its manufacturing phase might be causing the emergence of high amounts of toxic waste for disposal and recycling. The manufacturer has to take into account the environmental impact of the recycling and disposal phases as well, during the design of the product (Niemann et al., 2009). "Increasing material efficiency in operations; designing products with reduced mass, packaging, or life-cycle energy requirements; replacement of virgin materials with post-industrial or post-consumer wastes; reducing transportation requirements in the supply chain, thus reducing fuel and vehicle utilization; substitution of electronic services for material intensive

[16] In the literature this approach takes several different names. Princen (2002) names this approach "production angle", while Spaargaren (2011) calls it "the structuralist paradigm". Although in my thesis I will use the term 'production oriented paradigm' to be consistent with the rest of the terminology I used in the thesis, the meaning of the term will be the same as described by these authors as well.

services; and substitution of services for products'' are among the common methods proposed for dematerialization (Fiksel, 2009, p.124-125). However, it is argued that practical implications of the life cycle thinking[17] have been mostly on the production stage, targeting dematerialization during production (usage of less energy or reduction of pollution caused by manufacturing, etc.). Life cycle stages like raw materials acquisition, use & consumption and final disposal phases, which can have more direct consequences on reducing the total throughput, have been neglected to some extent (Mont and Bleischwitz, 2007; Hertwich, 2005).

Figure 8: A Simplified Life Cycle Assessment[18] framework. (1: Including transportation and processing 2: Maybe subdivided into energy and materials, or renewable and nonrenewable 3: Industrial and post-consumer Source: Cooper, 2005,p.56)

	LIFE CYCLE PHASE				
IMPACT CATEGORY	Raw materials acquisition[1]	Manufacturing	Distribution	Use	Disposal
Resource consumption[2]					
Air emissions					
Water emissions					
Solid waste[3]					

On the other hand, recently 'resource extraction' stage has started to take significant attention in e-waste debates in the literature and policy making. Two reasons are addressed for this change. The first one is the economic motivation for dematerialization; to reduce raw material usage, in particular usage of rare earth metals[19] for the electronics industry. Information on the prices of raw materials [20] address the fact that rising prices make it more and more difficult for corporations to make profits which are very much dependent on them to create value (Niemann et al., 2009). It is argued that a transition of the system through measures that reduce the consumption of raw materials will not only benefit the customer through lower prices, the society and the environment through the use of less amount of resources; but can also profit the companies through cost reduction. The second reason is the security of long term raw material supplies, particularly for high-tech industries such as ICT and renewable energy production (Hieronymi, 2012). Increasing consumption of electronics and forecasts that address even higher consumption rates particularly in developing countries means increasing consumption of raw materials as well. It is predicted that this situation may create extra pressure on the mining sector, which takes the attention to recycling and using recycled materials from e-waste for the manufacture of new products (Hieronymi, 2012).

[17] Figure 8 shows a basic framework for life cycle assessment. The stages of the life cycle of a product and the categories that are considered for dematerialization can be seen

[18] "Life cycle assessment is a tool to assess the environmental impacts of product systems and services, accounting for the emissions and resource uses during the production, distribution, use, and disposal of a product" (Hertwich, 2005, p.4673)

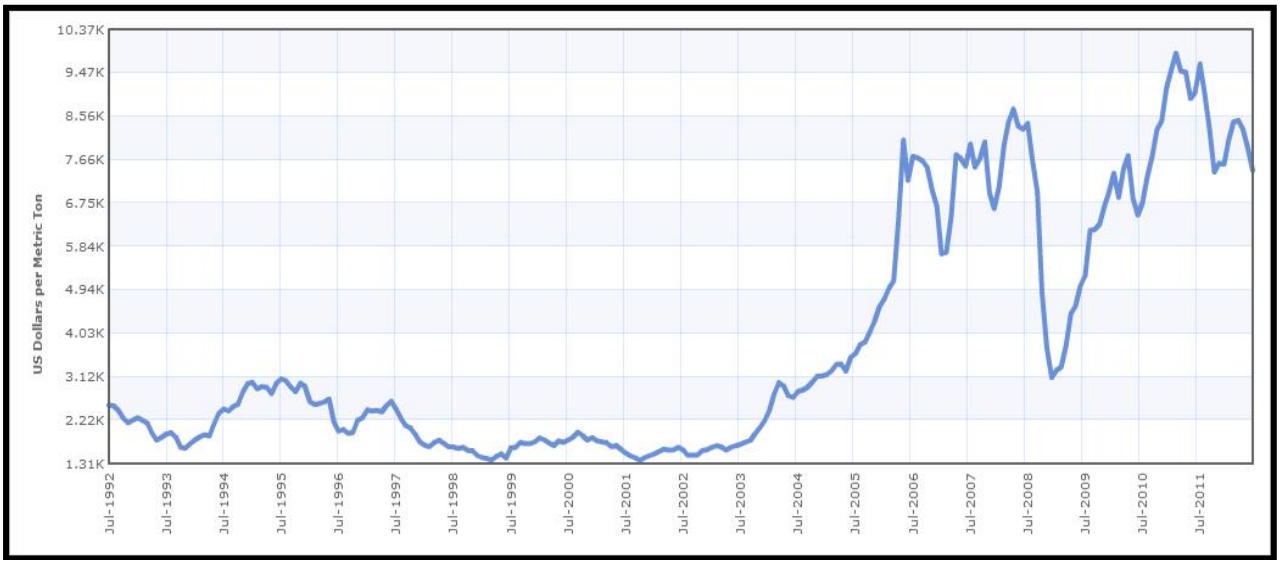
[19] Rare earth metals or rare earth elements is the term used for 17 chemical elements in the periodic table, consisting of yttrium, scandium and the 15 lanthanides.

[20] See Figure 9 & Figure 10 for the dramatic increase in prices of gold and copper in the last 20 years. Both of these metals are widely used in electronics industry, especially in ICT. Today, a PC can typically contain 1 g of gold. Also, 1 ton of e-waste can contain up to 200 kg of copper (Hilty et al., 2006). Also, Figure 8 shows the dependency of electronics industry to certain (some rare) metals.

Figure 9: Usage of selected metals (Source: Hieronymi, 2012, p.241)

Metals	*Worldwide Production (t)*	*% Used by Electronics Industry*
Indium	480	79%
Antimony	130	50%
Silver	20.000	30%
Copper	16.000.000	28%
Cobalt	58.000	19%
Lithium	25.400	25% (mainly batteries)

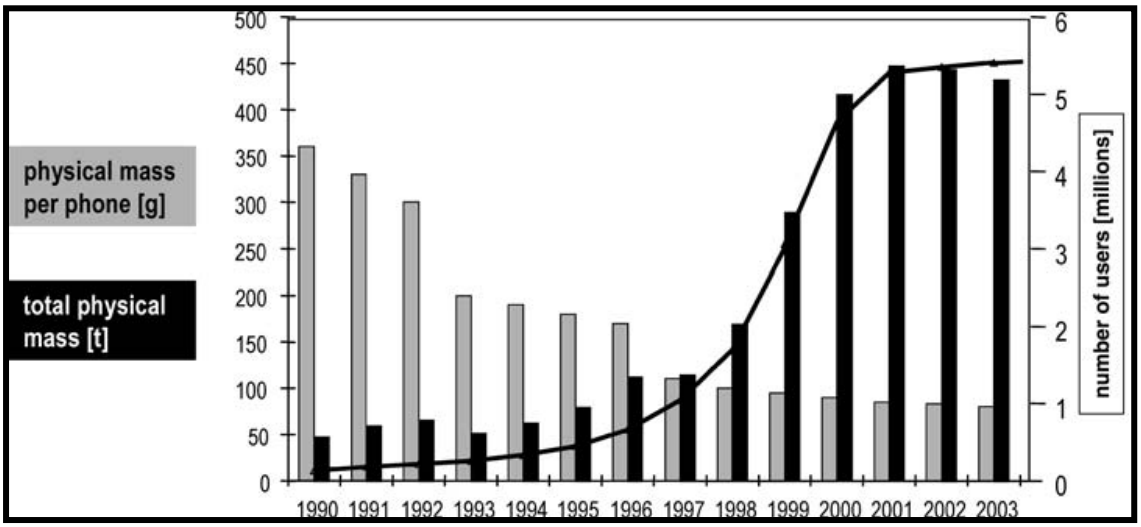
Figure 10: Copper prices between Jul. 1992 and Jul. 2012, dollars per ton (*Description: Copper, grade A cathode, LME spot price, CIF European ports, US Dollars per Metric Ton,* Source: http://www.indexmundi.com/commodities/?commodity=copper&months=240 **Retrieved on 8 August 2012)**



Nevertheless, it is not quite certain whether with the current trends of product consumption, practical examples of the life cycle thinking that has been implemented until so far will be enough to decrease the overall throughput. With increasing rates of obsolescence of various products, but especially electronics, the effort to minimize materials used for manufacturing can be neutralized in the end. Although especially the ICT has gone through remarkable transition in terms of time and materials efficiency since the first PC has been sold, the use of scarce materials has increased dramatically, creating risks with future availability. In addition, in terms of total mass flow, the "miniaturization of the ICT devices has been counteracted by the growing numbers of devices being produced" (Hilty et al., 2006, p.32). For instance, taken from a case study conducted in Switzerland, Figure 10 shows that the decrease of average mobile phone mass is much smaller compared to the increase of total mass of mobile phones being used between 1990 and 2005. While the average mass of a mobile phone has decreased significantly from 350 grams in 1990 to about 80 g. in 2005 (a reduction by a factor of 4.4.), the increase in the total number of subscribers resulted with an increase

of the total mass by a factor of 8.0. Hilty et al. (2006) argue that future developments in the ICT arena do not really promise a change that can lessen the increase in total mass flows. Some future visions for the industry like 'pervasive computing' or 'ubiquitous computing'[21] are argued to be in line with the dematerialization approach. These visions promise that traditional desktops or computing devices, which create a lot of material waste, will not be necessary anymore. However they also can mean a dramatic increase in the number of smart, networking objects surrounding human environment, with millions of new components installed in these objects to make them smart. According to Hilty et al. (2006) with the ICT usage rates of particularly developed countries, these transitions towards even more miniaturized ICT can result with at least the continuation of current e-waste production rates. That is why lengthening of product lives should be an important aspect of life-cycle thinking, which has not received enough attention of the policy-makers and businesses so far.

Figure 11: Development of the physical mass of mobile phones in Switzerland. The bars denote the mass per phone in grams and the total mass in metric tons, respectively. The line shows the number of users in million persons. (Source: Hilty et al., 2005)



1.2. Product Longevity

Discussion of product life-spans within the life-cycle thinking takes relatively marginal space among the production oriented policy solutions for sustainability problems (Cooper, 2005) and e-waste problem in particular. Most of the studies on sustainable product life-cycles focus on material and energy efficiency, but the life-cycle assessments hardly take into account product life spans[22] (Cooper, 2005).

Two approaches can assist to increase resource productivity through lengthening product lives: 1. Increasing durability of products and redesigning products and components for longer usability 2. Reusing and refurbishing products and components (Cooper, 2005). However, opting for longer lived products can bring challenges for the manufacturer to maintain its prior economic gains,

[21] Ubiquitous computing (or pervasive computing) is a future vision for the ICT world that various everyday objects surrounding human environment will become 'smart', able to connect to internet and network with each other. By this way, technologies will disappear into the background and people will be able to accomplish their everyday activities without necessarily being forced into consciously using technology. Instead, technology will fit the human environment in the case of ubiquitous computing (York and Pendharkar, 2004).

[22] Figure 8 displays a sample life cycle assessment chart.

because of possibly increasing prices of products and decreasing demand. Manufactures may be motivated to take measures to change their business style if these measures can promise economic success or at least neutrality. To achieve transformation of product life cycles in line with ecological concerns and economic success at the same time, it might be necessary for manufacturers to bring certain changes on their business processes. These changes basically aim to de-materialize their business by shifting the main focus of their economic activity from physical products to various services such as maintenance, remanufacturing, component reuse and recycling (Niemann et al., 2009). Provision of such services will also close the product life-cycle loops and will enable the manufacturers to follow their products and their ecological impacts through the entire life cycles from a closer perspective. In addition, as Cooper (2005) argues, by this way "a shift to more highly skilled, craft-based production methods and increased repair and maintenance work would provide employment opportunities to offset the effect of reduced demand for new products." (p.55)

I believe that product longevity is one of the most crucial proposals because the target is controlling (and even reducing) the throughput of the system. Although it comes from a production point of view, the aim is to decrease consumption rates through enabling longer product life spans. Therefore it is not necessarily the more production & consumption of new and more environmentally efficient (with energy and material consumption) products that is being suggested. The objective is also to make the products, which consumers already own, have longer usability lives. So, increased ownership, which is one of the factors behind increasing electronics consumption, is not a matter of analysis for product longevity discussions. However, another factor–planned obsolescence – is directly addressed. By this way, these proposals aim a reduction in the consumption of final products; and consequently a reduction in the rates of waste production as well.

One of the policy responses that were developed with the goal to enable product longevity has been EPR (Extended Producer Responsibility). EPR was issued by the EU within the WEEE Directive in 2003. The objective was to make manufacturers responsible from their products not only while they produce and until they sell them; but through the whole life cycle of the product. The policy aimed to hold manufacturers accountable for the full costs of their products at every stage in their life cycle. The hope was that if manufacturers had to deal with the end of life versions of their products under legal schemes that force recycling or disposing in environmentally appropriate conditions, they will be more likely to design their products more easily and safely handled at each step in the lifecycle. Knowing that they have to bear the costs of recycling or disposal, manufacturers would be more inclined to redesign their products in a manner "that takes into account the upstream environmental impacts inherent in the selection, mining and extraction of materials, the health and environmental impacts to workers and surrounding communities during the production process itself, and downstream impacts during use, recycling and disposal of the products."(Smith, 2009, p.11). It was believed that through EPR, product longevity and ecological design of the electronic products could be achieved.

However, whether EPR could have any effect on product longevity and minimization of e-waste is heavily disputed in the literature. The majority argues that that, although the aim is minimization of e-waste through improving the obsolescence rates, the policy could not really achieve to create any significant impact (Gottberg et al., 2006).[23]

1.3. Designing Products from "Green" Materials

Usage of green materials for the manufacturing of electronic products, or in other terms (used in literature) *detoxification, trans-materialization or eco-design* is one of the popular proposals for the

[23] The reasons will be further explained in Section 4.3.

e-waste problem from the production oriented paradigm (Ladou & Lovegrove, 2008). The term refers to "the prevention or reduction of adverse human or ecological effects associated with materials use" (Fiksel, 2009, p.134) through "shifting away from hazardous and non-renewable resources toward safer and/or renewable or reusable materials (Mulvihill et al., 2011, p.272). By definition, reduction of hazardous materials and emissions during the manufacturing of goods can also be included within detoxification; however since the scope of this study is about waste electronics, negative impacts of the electronics industry that emerge during and for the production processes are not included here.

The main argumentation behind detoxification is that since the major damage e-waste creates on environment and human health is caused by the release of toxic materials during disposal or recycling, if these substances are replaced with benign ones, the e-waste problem can be solved to a higher degree. For instance, research has determined that brominated flame retardants and PVC in plastic materials, which are widely used in various electronic goods is highly toxic and this material have been eliminated from some electronic products (Fiksel, 2009; Chemsec, 2010). The RoHS Directive issued by the European Union in 2006 is one of the most well-known detoxification policy proposals.

Acknowledging the polluting aspects of e-waste and forcing electronics companies to change their design towards more ecologically compatible manners is a positive step. Nevertheless overemphasis of this approach alone reflects as if the e-waste problem is only a pollution problem and once the hazardous aspects are eliminated, the e-waste will not be a severe sustainability problem anymore. More than half of the e-waste material is metal (Mulhivill et al., 2011), which is not accepted as hazardous material; but increasing amounts of e-waste even if there were no hazardous materials involved creates many problems about volume, recycling and raw material issues with these metals being wasted. Overemphasis of the detoxification approach by policy makers has shunted the concerns about these problems to down below the e-waste policy agenda.

2. More Efficient E-waste Management and Recycling System

Since dealing with waste can also generate economic activity and contribute to growth, one of the mainstream proposals from the production-oriented paradigm is to transform e-waste problem into an economic opportunity by creating formal e-waste industries. From this angle, increasing rates of electronics consumption and the consequent e-waste production can/should be turned into prospects for the future to contribute to economic growth. The throughput is not really considered as a problem on its own, and all the resource consumption that will be necessary for this improved throughput is overlooked. In the end, the increased energy or water consumption for the improved throughput would also become a production related problem, which would need to be solved through better and more efficient productive methods. Accordingly, as long as waste enters back to the formal production chain, there is no problem about where/how it is handled. That is why, according to Clapp (2002a) the general attitude of governments on waste problems including e-waste have had much more emphasis on creating jobs and attracting investment in the disposal sector. By this way, the aim is to include the disposal sector as much as possible to the formal economic system of the country and to try to make the best out of it as possible.

A circular economy with well-working recycling systems is a prerequisite for sustainability but may not be sufficient if resource throughput remains high. In addition, sustainability will not be achieved if improved efficiency is offset by increased consumption. According to a report by the World Resources Institute (2000), although industrial economies are becoming more efficient in their use of materials, waste generation continues to increase. 50% to 75% of annual resource inputs to

industrial economies are returned to environment as waste only within a year. So, increased consumption creates waste at a far higher rate than that reduced by increased recycling.

Even if hypothetically the best recycling methods were found that would ensure 100% recycling rates of all the materials used for the manufacturing of electronic products, it still may not be able change the significant environmental footprint of electronics industry. For instance, semiconductor manufacturing is one of the most resource-intensive industries (Fiksel, 2009). According to a study conducted by Williams (2004a), to produce and use a 2 gram microchip, 1670 grams of fossil fuel and 72 grams of chemical inputs are needed. The environmental weight of the semiconductor is not as small as its actual size: Fossil fuels used in the production are almost 600 times the mass of the final product, which is far larger than many traditional goods such as refrigerators or cars (Figure 12). According to another research by Williams (2004b), the manufacturing of a desktop computer necessitates an estimation of 260 kg of fossil fuels, which is almost 11 times its weight. Combined with the obsolescence rates, annual life cycle energy burden of a computer becomes 2600 mega-joules (MJ) per year (1.3 times the energy burden of a refrigerator), which is relatively high for a home appliance that is not used all the time (compared to a refrigerator for instance).

Figure 12: Comparison of energy used to manufacture and mass of different products (Source: Williams, 2004a, p.5)

Product	Total fossil fuels (coal, oil, gas) used in manufacture (kg)	Mass of product (kg)	Fossil fuels used for manufacture/ mass of product
32MB DRAM chip	1.2	0.002	600
Passenger automobile	1000	1200	0.83
Refrigerator	53	35	1.5

Moreover, research shows that despite the positive portrayal, recycling has negative impacts on the environment as well, which are not always fully recognized. That is why recycling may be offering a 'relatively less bad' solution to waste problem. According to Cooper (1994), collection, sorting, cleaning and separation of waste products into constituent materials are all energy consuming processes. For instance, the research by Barba-Gutierrez et al. (2008) shows that recycling and collection of WEEE can become even more environmentally damaging than not collecting e-waste if the collection networks are not designed carefully. So, the environmental benefits of recycling depend on several circumstances that need further attention and evaluation. Moreover, pollution is caused as a by-product of these energy consuming activities as well as by materials reclamation processes. According to a study by Hischier et al. (2005), especially the recycling processes for the further treatment of products to obtain secondary raw materials out of them cause significant environmental impact with hazardous emissions. Also, the following manufacture, distribution and possibly recycling of products made from these recycled materials will also have a negative environmental impact. Therefore, as long as the throughput continues to rise, resource consumption– at least in terms of energy and water, and environmental damage – in terms of resource consumption and pollution may continue to increase, even with well-working waste recycling systems.

Critique: Why Production Oriented Approach is not Enough

Embracing the production oriented approach as the primary solution for sustainability issues, including the e-waste problem, can bring challenges for the future. First of all, although over-consumption is one of the major causes of the emerging waste problem, focusing only on production methods (either e-waste management or manufacturing of electronic products) reflects an incomplete evaluation of the problem, and fails to "square the circle" as Jackson (2006) states (p.18). Moreover, Shove (2005) adds, "in concentrating so exclusively on improving efficiency, energy and environmental policy has arguably lost sight of the cumulative consequences of changing conventions of everyday life" (p. 1062). The solution of sustainability related problems should not be developed only through exclusively focusing on improving efficiency of technologies and developing related environmental policies. Policy makers need to take into account the effect of daily-life practices on sustainability problems and should track the evolution of these practices under the influence of social, technical and institutional dynamics. This means paying attention to "the intersection of actors' definitions, understandings, competences and senses of obligation on the one hand and to rules, resources, institutions and infrastructures on the other" (Shove, 2005, p.1062). By trying to organize environmental change only through new technologies or infrastructures, policy makers are somehow underrating the crucial role played by the human agents in process of environmental change and being trapped by technological determinism (Spaargaren, 2011).

Secondly, more efficient production of electronic products or efficient recycling systems are not really answers to the question why e-waste problem has emerged at first hand. They are "only palliatives; temporary, stop-gap measures to postpone real decisions about a real problem that, conventionally defined, appears intractable" (Clapp & Princen, 2003, p.39). According to Clapp (2002a) overemphasis of the production oriented approach reflects as if "the issue is not one of 'too much', that is, too many items consumed per person or just too much consuming in the production process" (p.156). Rather, the attention is devoted to what to do with the waste, instead of finding the root causes of the increase in waste volume and developing ways to decrease the amount of waste. She agrees that a change in the lens is necessary for a thorough understanding of the waste issue. Questioning consumption is very crucial so that the attention can be directed to "the contribution of consuming to the generation and distribution of waste" (Clapp, 2002a, p.3)

Third, if the e-waste management, recycling and disposal methods of the developed countries were working as they are argued to be, then we would not be speaking of (legal and illegal) e-waste transports today. The problem would only be of country or region specific failure of the e-waste handling systems. However, the amounts of exported e-waste from the developed countries to poor countries show that even the best e-waste management systems that are shown as good examples are somehow failing to prove the promise of "good technology". Moreover, it can be said that these supposedly well-working systems are actually exporting a big proportion of the already existing issues related to e-waste. In some terms they can be defined to be successful because they are in a way protecting the citizens of the owner country and leaving others to deal with the consequences.

The fourth reason is that, if the real goal is to reduce damage created on the environment as a result of consumption, increasing efficiency will not always be the best way to achieve it. As long as consumption continues with the increasing rates, efficiency measures may not be able to really compensate the rates of increase and there may still be an absolute increase in the depletion of resources in the end.

Finally, promotion of technical efficiency can indirectly mean institutionalization of the practices and lifestyles which are resource intensive and create the problems that cause a threat to limited resources and sustainability, because "technological strategies do not simply meet demand, they also help construct and sustain it" (Shove, 2005, 1058). Before all else, policy makers should try

to understand why these practices and consumption patterns, which actually cause or contribute to some of the sustainability related problems, have become normal and widespread around wider populations of people. New technologies can improve environmental damage in more resource efficient manners but whether they can change over-consumptive patterns and practices is doubtful. More importantly, they may be contributing to the normalization of these inherently unsustainable practices. As Shove (2003) argues, "the conclusions of scientific research are embedded in codes and standards that are in turn reproduced in the built environment and in people's expectations of what it should be like" to be comfortable, clean or convenient (p.399). These expectations can influence the social practices of domestic life and describe the "necessary" and "needed" items, arrangements, devices and services of people's daily lives. Therefore, to conclude, "the real environmental risk is of a sweeping convergence in what people take to be normal ways of life, and a consequent locking in of unsustainable demand for the resources on which these ways depend" (Shove, 2003, p.416).

3.3. Irresistible Free Trade

According to mainstream economics, free trade brings benefits to everyone involved and these benefits stem from the difference in efficiencies of different countries with the production of goods. If countries choose to specialize and focus producing the goods they are comparatively advantageous with, costs can be minimized, compared to the case where each country producing everything. Added with the free trade of these goods that are produced at regions with comparative advantage, the result will be higher total production and higher share of each country from this increased production (Ropke, 1994). That is why intervention that can reduce these benefits should be prevented and trade should be free, with full trust to the economic system consisting of the market incentives, costs and prices. The market will arrange transactions in the most beneficial way possible for all the parties involved.

Based on the fully embracement of these premises by the policy and business actors of particularly the developed world, economic globalization brought an increasingly global organization of production and trade. Especially since the 1980s, the drive to economic liberalization has resulted with the removal of various trade barriers. The barriers in front of waste trading were also removed simultaneously, resulting with a global waste collection business. Particularly the private industrial waste disposal industry has become ever more global in scale and practice and transformed into one of the fastest growing markets. E-waste is one of the recent and most profitable transaction objects of this industry.

However, in the case of waste trade and particularly e-waste, free trade paradigm needs careful evaluation, because the premises may not be working as assumed. The multidimensional nature of waste can bring unexpected outcomes if it is primarily treated as an economic good. Waste problem is essentially a sustainability issue, and the role waste plays as an object of trade transactions can overshadow the "interregional dimensions of sustainability" (Kissinger et al., 2011, p. 970). Principle 2 of the Rio Declaration states: "*States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental and developmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction*".[24] The declaration was prepared at the 1992 United Nations Conference on Environment and Development (the other name, the Earth Summit) to lead sustainable development pathway in the future. With this principle, the document emphasizes the responsibility of states to deal with their own activities that can create environmental damage, not

[24] http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm Retrieved on 7 February 2012

only within the borders of their land but also in other lands. However, I argue that the free trade of e-waste – transportation of the 'sustainability problem' of one country to another – contradicts with this principle.

Moreover, depending on the socio-economic dynamics of the receiver country, it can also contradict with the basic promises of the free trade paradigm as well. Benefiting from the comparative advantages of production brings welfare globally with free trade, according to the paradigm. Can we really speak of an improvement of welfare only by looking at the lure gained by some parties, while the others suffer from the social and environmental damages it can cause? Whose welfare would that be? In this part of the thesis, I tackle with these questions and explain the answers given in the critical literature.

The reason why waste transportation fits well with comparative advantage

The last decades have witnessed significant change in waste disposal methods in especially the Western developed world. First, dumping waste in the oceans has been banned through a serious of attempts starting with Oslo Convention (regional treaty) and the London Dumping Convention (global treaty) both in 1972 (Parmentier, 1999). This led to increased land-filling and land-based incineration of waste. However, according to many sources, land-fill spaces in developed countries have been shrinking rapidly. Moreover, studies show that land-fills especially of hazardous waste leak and incinerators release toxic air pollutants and ash (Grossman, 2006). In most of the developed countries, public pressure against the generation and land-filling of toxic waste has resulted with the closure and cleaning of some of the disposal sites and implementation of stricter regulations in waste disposal in general (Grossman, 2006). As a result of these developments the costs of waste disposal have increased dramatically in the developed world. Equally, the costs of waste incineration and waste recycling under strict health and environmental constraints have risen as well. With the increasing consumption rates of goods and thereby rising amounts of waste produced, stricter regulations and higher costs of dealing with waste has created pressure to export the problem.

In the meanwhile, developing countries, most of which have not passed through similar transformation about environmental policy, have emerged as suitable locations to get rid of the increasingly expensive waste of the developed countries. According to the principles of conventional economics, this is a rational and plausible solution. The controversial statements of the then-chief economist of World Bank, Lawrence Summers, taken from a memo within the Bank, explain the basic logic of why it is perfectly plausible to transport toxic waste to poor countries explicitly:

> "The measurements of the costs of health impairing pollution depends on the foregone earnings from increased morbidity and mortality. From this point of view a given amount of health impairing pollution should be done in the country with the lowest cost, which will be the country with the lowest wages. I think the economic logic behind dumping a load of toxic waste in the lowest wage country is impeccable and we should face up to that… The demand for a clean environment for aesthetic and health reasons is likely to have very high income elasticity. The concern over an agent that causes a one in a million change in the odds of prostrate cancer is obviously going to be much higher in a country where people survive to get prostrate cancer than in a country where under 5 mortality is is 200 per thousand. Also, much of the concern over industrial atmosphere discharge is about visibility impairing particulates. These discharges may have very little direct health impact. Clearly trade in goods that embody aesthetic pollution concerns could be welfare enhancing. While production is mobile the consumption of pretty air is a non-tradable."[25]

[25] The memo was reported with the article "Let Them Eat Pollution" on The Economist on February 8, 1992. http://my.ewb.ca/postfile/21389/LetThemEatPollution.pdf Retrieved on 23 February 2012.

According to this thought, it is logical based on the conventional economic principles, to transport all the waste created in the developed, most probably populated countries to poor countries with lower population, simply because: 1. Most likely they have much lower wages; thus lower cost of pollution, since the cost (damage) of pollution is measured in terms of lost wages due to pollution related sickness and death 2. Many of these poor countries are under-polluted compared to industrialized nations 3. There is less concern for pollution; thus less demand for a clean environment in poor countries. In addition to the assumption that the cost of pollution is lower, cost of dealing with waste (and pollution) as an economic activity is also low because of the absence of strict regulations and health constraints. Therefore as the comparative advantage principle suggests, it is much more logical to transport and deal with waste of rich countries in developing countries. It will bring better outcomes in the end for both sides, according to this logic.

Free-Trade Paradigm and Ecological Interdependence

The world is becoming increasingly interdependent. Especially for the last two centuries, inter-regional connections are getting thicker and wider; transforming into a complex and constantly busy web of economic, political and social relations. That is why changes in political, social or economic context in one part of the world can affect the other parts of the world faster than ever before. In this context and in spite of the high awareness of political institutions as well as the business spheres on the global connectedness, environmental policy and sustainability efforts are most of the time limited with local or national spatial scale. Even with issues which are accepted on the mainstream level to be global, such as climate change, the framing of the problem is discussed with a fragmented and voluntary approach from individual states, which does not really involve a realization of the interconnectedness of regions, countries and ecosystems (Kissinger and Rees, 2010). However, this approach contradicts with the very core of the sustainability efforts under the reality of the ever-more interconnected world we are living in. As Kissinger et al. (2011) point it out:

> "…in an ecologically full world, one approaching or beyond biophysical limits; a world in which activity in any one region can generate environmental impact on other regions and even the entire ecosphere; a world in which resource scarcity and the consequences of ecological changes are becoming major security issues, disjointed single-scale approaches to assessing, quantifying and acting toward sustainability are futile. It has become essential to incorporate trans-regional across-scale dimension in both national and global policies for sustainability." (p.966).

The neglect of the global interconnectedness of ecosystems shows itself through various cases where reverse feedback in different industrial fields spreads health and environmental hazards all over the world. For instance, according to news reports, it was found that some toys and jewelry produced in China and imported to the Western world included hazardous chemicals which could be poisonous. The chemical analysis of these products showed that materials obtained from e-waste recycling were used for the manufacture of these toys and jewelry (Cutillo, 2010). Considering the huge proportion of products imported from China to Western countries (For instance, 80% of the toys sold only in the US come from China (Cutillo, 2010)), high levels of cadmium and lead found in especially children's toys and jewelry in the US has raised the attention towards the toxic Chinese imports. Millions of Chinese manufactured toys were recalled by companies like Mattel and Fisher Price. Studies conducted by scientists on these products revealed that the chemical footprint of the toxic materials found in these imported goods were actually coming from the materials recovered from e-waste, which most probably travelled from Western countries like the US to China. Thus, the irresponsible

handling of e-waste on single dimensional consideration, via neglecting the interdependence of sustainability, not only poisons the Chinese children living in e-waste receiving regions, but also threatens American (or Western) children as well. The global round trip these toxic materials take, "toxic reciprocity" as Cutillo (2010) calls, shows an important fact about increasing global interconnectedness of sustainability and takes attention to the fact that "people in most countries and regions today have direct and indirect interests in sustaining the vitality of ecosystems in other regions" (Kissinger et al., 2011, p.966).

Another reverse toxic feedback on e-waste trade has emerged in one of the most unexpected and risky fields: security. According to Business Week[26], the US military services are facing a great threat due to the counterfeit computer components such as chips imported from China that are used in warplanes and ships. Several reports on instant failures and malfunctions of crucial military equipment could trace back the root cause of these breakdowns to fake microchips which were imported from China. These fake parts can cause accidents as well as foreign espionage, according to Business Week. One of the interviewees quoted for the reportage states that "as many as 15% of all the spare and replacement microchips the Pentagon buys are counterfeit" causing regular failures within the weapon systems. The part of the story that reveals the toxic reciprocity of e-waste exports appears once the supply chain of these fake chips are investigated: The recyclers and refurbishers working under completely unprofessional and hazardous environments in e-waste recipient regions like Guiyu take the chips from old electronics, clean and sell them to larger traders. Large traders refinish and repaint them, by sanding the old markings and dates on the chips and labeling them as if they are durable, military chips. The cost minimization efforts of the US military services and Pentagon leads them to small brokers that do business with these traders, which generally sell relatively cheaper products compared to brand manufacturers and well established distributors. As a result of the global interconnectedness of sustainability, the crude and unsustainable methods of e-waste recycling and refurbishment in one corner of the world could create damage not only in the surrounding regions, but also could travel thousands of kilometers and give damage to far away corners of the world.

Free Trade as Promoter of Unsustainable Consumption

Since there is less number of landfills to dispose the waste in the industrialized countries and the regulations are much stricter, waste (not only e-waste but also plastic, paper etc) started to travel longer distances, mostly to developing countries and poor regions. Through the channels fostered uncontrollably by the free trade paradigm, particularly developed countries, which have high-income levels and more dense populations, have been exporting their "ecological footprints" to all over the world, but especially to poor countries which have larger un-urbanized lands. This created somewhat of an illusion on the public of developed countries, as if there are still many available (and enough) spaces to hide the waste in and the consequences of over-consumption are marginal compared to its benefits. Through the same transnational commodity chains that have emerged with globalization and free trade, the public of these countries, which are mostly import-dependent for various industries, could continue to consume and dispose in increasing patterns; and create the ecological footprints of excess consumption, because their countries are not exposed to the ecological damage created by their resource demands.

However, the mental detachment of consumers and their waste start from the first moment their waste gets out of their hands through the mass production channels of the techno-economic system. Waste is collected from the producers of waste through mass disposal and waste management

[26] http://www.businessweek.com/magazine/content/08_41/b4103034193886.htm Retrieved on 14 April 2012.

systems and taken “away”. Clapp (2002a) defines the “away” phenomenon as both geographically, which became more available with globalization, and mentally far away point, distant enough so that consumers do not see the direct ecological and social consequences of waste. By this way, free trade of waste serves for “distancing” of waste from the actors − people/firms/countries − that actually create the waste. According to Clapp and Princen (2003), distancing of waste enables the creators of waste to feel less and less responsible from their consumption and wasting; therefore makes “cradle-to grave accountability” nearly impossible. Moreover, trade of waste and all the discussions it brings from legal and economic aspects of the problem attracts the global attention only to “where” to dispose the waste, while the real quest should be to understand “whether so much of it should be generated at first place” (p.39).

The result of distancing is delaying to face up the overconsumption and garbage of the developed world. Once waste is “out of sight”, then it gets “out of mind” as well (Clapp & Princen, 2003, p.40); since “consumers lack the information and direct negative feedback that might otherwise induce them to behave more sustainably” (Kissinger et al., 2011, p.968). Consequently, free trade indirectly contributes to over consumption, by making it much easier, available and less costly in economic and ecological terms. Although in the short term the consequences may not be that visible especially for the countries that send their waste away, in the long term, this means the waste sink capacity of the Earth is being used up.

Free Trade of E-waste as Disguised Disposal

Some scholars support a global reuse and refurbishment industry for second hand electronics, arguing that it creates income, employment and innovation opportunities for the people of the developing countries (Williams et al., 2008; Vallauri, 2009). They add that as long as e-waste is handled under proper conditions in the destined areas, its trade can be beneficial for both the senders and the receivers. Moving from this argumentation, they assert that the solution for the global e-waste problem should based on easier trade of e-waste that is supported with transfer of better e-waste management technologies to developing countries.

However, this argumentation ignores the fact that waste is a “where” problem; the health and environmental damages emerge at the destination where waste arrives (Clapp&Princen, 2003, p.39). Since the free trade logic and conventional economic thinking insists on seeing waste only as an economic good, the whole world becomes the commercial stage of waste. On the other hand, the root cause of the e-waste pushing mechanisms is not solely commercial. As explained before, the purpose of e-waste export from the developed countries is to get rid of the waste with minimum cost; therefore it has not really mattered for the e-waste providers how and where waste will be handled, as long as it is sent away. Awareness about the lack of recycling & refurbishment capabilities of recipient regions is higher than ever before in the West, and recently some countries like have imposed bans for e-waste imports to their countries (UNEP, 2009). However e-waste traffics still continue under the guise of recycling or reuse, which is a legal type of trade according to the Basel Convention (Basel Convention, 2012b). Therefore, other scholars argue that e-waste trade, even for productive targets like recycling or reuse, is actually a disguised disposal (Kamuk &Hansen, 2007).

The demand types that pull e-waste from the Western countries tend to differ according to the country. For instance, much of the e-waste currently sent to African countries is done for reuse purposes, because there is a considerably high demand for second hand electronic products in the African continent. On the other hand, although the repairing business may be thriving in African countries and creating income source for the people living in those regions (Vallauri, 2009), data on efficiency of these activities show that because the capacity to deal with the refurbishment of waste is so low, most of the waste ends up in landfills and informal dump sites (Kimani, 2009). Moreover,

much of the second hand electronics which are labeled to be for reuse are not actually working or even fixable. Only a small proportion of these can be given a second life by the refurbishers and the rest find themselves either in landfills, or just thrown around, or melted to obtain the precious metals with open fires under not optimum conditions. According to a report by Basel Action Network from 2005, almost 75 percent of the second hand electronics sent to Lagos in Nigeria from the US and Europe cannot be sold or repaired because they are already not working and not possible to refurbish (Electronics TakeBack Coalition, 2011). Consequently, the economic benefits brought by the waste trade can become marginal once the damage it creates on the recipient, the profit gained by the traders and the cost avoided by the importers are considered.

Unfortunately, this is also the case for the second hand electronics sent to Africa for aid and donation purposes. Various development projects from NGOs and other organizations have adopted helping the poor countries especially in Africa to close up their ICT gap with the rest of the world as a development strategy. For this purpose, thousands of second hand PCs and ICT electronics have been collected, repaired if necessary and sent to poor countries for reuse purposes. However, almost none of these projects have involved any responsibilities from the donor institutions about assistance with the equipment when they become obsolete. Moreover, according to several journalist reports, more than 50 percent of the second hand computers sent to Ghana for donation purposed are actually non-working, non-repairable electronic waste (Electronics TakeBack Coalition, 2011). Even if they are in working conditions, most of these reused PCs are disposed within the early years of their second (or third) use, because they are already old. In the end, poor countries have to face with the challenge of dealing with the waste of these equipments, from which they can benefit during a much shorter time than the complete product lifetime of a new item. More importantly, they face with this challenge when they are completely not prepared for it: most of the African countries lack the necessary disposal and recycling infrastructure systems and they face with increasing amounts of electronic waste by time. It is not clear, whether the benefits of the technological help with the free or very cheap second hand PCs is high enough to compensate the costs of dealing with the increasing amount of e-waste for these countries.

Under these circumstances, support for the free trade of e-waste has a high chance to indirectly turn into a support for the right of over consuming nations to export the environmental consequences of their over consumption.

4. A Critical Discourse Analysis of the Policy Organizations

4.1. Methodology: Why Discourse Analysis?

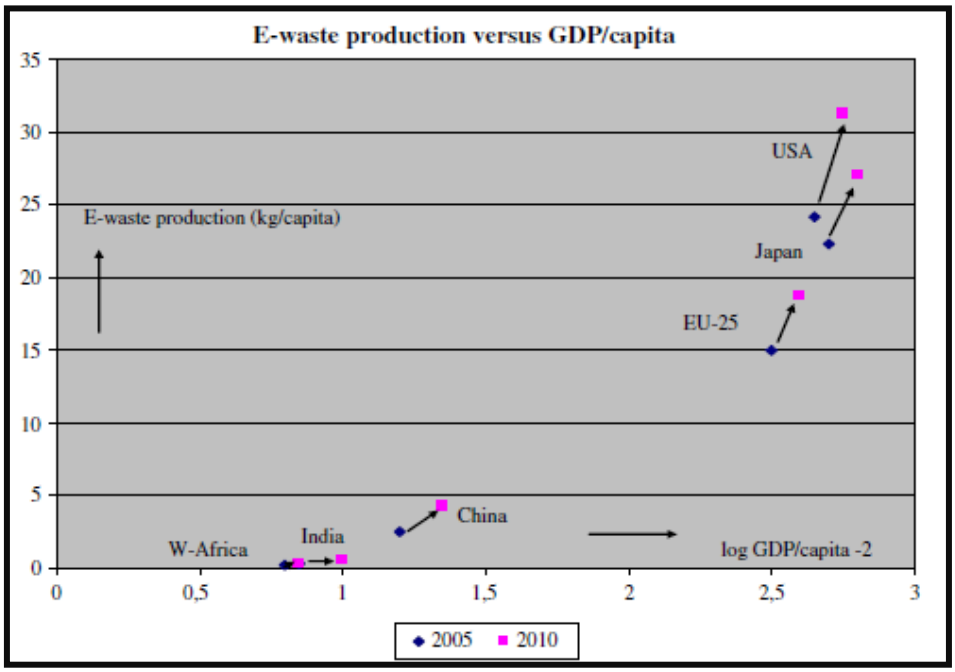
There seems to be a widely accepted view on e-waste: That the current situation of electronic waste is a serious problem and needs urgent attention from national and international actors (reports of all related institutions like the EU, the Basel Convention or Greenpeace and secondary sources like academic literature all define the e-waste situation as a 'problem'). On the other hand, data on e-waste flows and amounts show that in spite of this negative global perception about e-waste and e-waste flows, there is an increasing trend in e-waste traffics from wealthy countries to the developing countries. I believe this is a strong proof to show that the solution proposals until so far could not really have become successful. In addition, as have been explained in **Chapter 2**, there is no global consensus about how to define e-waste in policy-making. The different descriptions about what e-waste is can be resulting with different approaches towards addressing the causes of the problem and developing solution methods. That is why analyzing the policy proposals on e-waste by different institutions is important to have a better understanding of the meanings and perceptions on the problem itself. In my opinion, the differences and similarities of related institutions with reflecting on the problem and its root causes have an important role in shaping the contemporary e-waste problem.

In Chapter 3, I have constructed a systemic overview of the critical arguments on sustainability problems in the policy literature, with a concentration e-waste. I have argued about the domination of the three approaches towards the e-waste problem, which have their roots in the mainstream economic thinking. In this chapter I investigate the traces of these paradigms in the discourse of different policy actors. For this, I implement the *discourse analysis* methodology and use the recent documentations (reports, memo's, press releases, white papers) published by these institutions as well as their websites– all possible sources that constitute the discourse of an institution. I focus on the documentation produced after 2007-2008.

I use discourse analysis, because discourses play a role in understanding how relevant actors define environmental problems, shape their policy proposals and also create social and material realities (Hardy et al., 2004). For various problems related to sustainability, ranging from energy, water issues to waste, discourse analyses have shown how different actors, including scientists, public and politicians, interpret the issues and how these different interpretations can influence the global agenda (Hajer, 2005). Discourses act as agency: through the use of documents, texts in which discourses are embodied, and most importantly power, they create social realities (Hardy et al., 2004).

I look through the discourses of two governmental organizations (US-EPA and Japanese Ministry of Environment), two inter-governmental institutions (The EU and the Basel Convention) and two non-governmental institutions (NGOs) (Greenpeace and StEP). I have selected the EU, EPA and Japanese Ministry of Environment, because the EU, the US and Japan are the biggest e-waste producers (Figure 13). Their policy discourses for sure have an important role in shaping global e-waste policies. Basel Convention is the most important international organization on trans-boundary movement of e-waste. It is a dynamic platform to observe the struggle between all the different members through its discourse. StEP is a non-governmental think-tank on e-waste and involves participation of various actors, ranging from universities to electronics companies and recycling businesses. Finally, Greenpeace is one of the most well-known environmental NGOs and has initiated projects on e-waste. Discourse analysis plays a crucial role specifically in revealing how these distinct actors actively position themselves in the problem discussion, "try to influence the definition of the problem" and "exercise power through trying to impose a particular frame or discourse into a discussion" (Hajer& Versteeg, 2005, p.177).

Figure 13: WEEE production of regions in the world as a function of GDP/capita (Source: Zoeteman et al., 2010, p.422).



4.2. Methodology: Which Discourse Analysis?

Michel Foucault and Jurgen Habermas are the prominent developers of the two major approaches to how discourse analysis can be made. Since I aim to do critical analysis of the e-waste policies, it is important to discuss these two names to explain the method I will choose to implement in my study.

These two names have interpreted discourse analysis from different perspectives. It might be rooted in the difference of the meaning of the term *discourse* in the native languages of Habermas who is a German and Foucault, a French. In German, the term *diskurs*, which is a formal word, means a clearly defined debate about a specific topic; while the French *le discours*, relatively closer to the English meaning, stands for exchange of ideas. In addition French le discours is relatively less formal than the English and German terms, and is more part of the ordinary use of language. That is why, from origin, discourse for Habermas and and Foucault are not identical (Stahl, 2004).

According to Foucault, discourse analysis aims to understand the procedures and social interactions that shape communication and the societal process of understanding and self-definition. While doing this, Foucault emphasizes the importance of understanding how the different stakeholders of the discussion expose and use their power in negotiations for the production and structure of the discourse. Researchers that embrace a Foucaultian way of discourse analysis specifically focus on the language, the signs and symbols used in the language to impose certain beliefs and ideas to others, with the purpose to impact institutions and policy making (Hajer, 2005). So the emphasis is on discovering certain linguistic utterances and understanding how and for what purpose they are used within the discourse.

Foucault's approach aims to expose the hidden influences on discourses, the power relations and the normalizing effect these have on the terms used to describe certain phenomena. However, this approach does not involve any normative direction, which is the most basic difference with Habermasian discourse approach. For Habermas discourse analysis has a different aim: Because of the very nature of communication, that it means taking the other serious and as equally respectable, it

necessitates certain ethical aspects. That is why, Habermasian angle is widely used for addressing issues that have a significant ethical angle and importance. The analysis contains normative and factual considerations, and focuses on the validity of the discourse in the light of these normative and factual considerations. Moreover, Habermasian approach is highly critical because the normative and factual considerations construct how an ideal speech should be like and is used to identify the shortcomings of the analyzed discourse. That is why the content of the discourse and its validity is very important, maybe more important than the origin and genealogy of statements and what they aim to accomplish within a discourse (Brulle, 2002).

The analysis I want to accomplish on the e-waste policy proposals of important institutions surely includes a normative aspect: As well as I am interested in the way the discourse of various institutions are structured and the way language is used to create a certain way of rationality (Foucaultian), I have a keen interest in finding out whether these discourses have the "right approach" towards the e-waste problem, as I have proposed in the previous parts of this study. Briefly, the right approach should have the three characteristics: First it should cover an analysis of the whole chain of stages the e-waste problem comes into existence. Second, it should acknowledge all three aspects of the e-waste problem which occur during these interdependent chains. Third, an acknowledgement of the role unsustainable consumption, free trade and single focus on technology plays in the creation and continuation of the problem is necessary. Because I have a certain proposal for the' right approach' towards understanding the e-waste problem, Habermasian way of discourse analysis fits better with the critical analysis I want to make on the e-waste policies in this study.

Consequently, in this part of the thesis, I aim to accomplish two tasks: First, by using the framework I have constructed, I aim to assess and understand the approach of intergovernmental and governmental bodies and non-governmental organizations towards the e-waste problem. What I particularly wonder is whether the linear approach that most of the theoretical lenses addressing the e-waste problem have embraced finds place at the policy level as well. To be able to answer this question I will evaluate whether all the interlinked stages that have a role in the emergence of the contemporary e-waste problem is acknowledged at the policy level by governmental and intergovernmental institutions and non-governmental organizations.

Second, moving from the debate on production angle and the innovation-centered approach of the Transition Studies, I aim to assess the fundamental approach (paradigm) of the institutions and organizations that shapes their policies towards e-waste problem. The usage of discourse analysis in environmental policy making is particularly essential, because there are various actors involved in finding solutions to environmental problems, and as Hajer and Versteeg (2005) explain the number of these actors is "characteristically high" in environmental policy making (p. 177). For their solution proposals, each of these actors first tries to understand what the problem really is and bring their own definition.

4.3. The EU

General Approach towards Waste as a Sustainability Problem

At first glance, the EU embraces a very critical approach towards waste and waste generation. On the webpage of European Commission on Environmental Affairs, it is highlighted that the Union targets to diminish over-consumption and the consequent wasting, by "decoupling waste generation from economic activity, so that the EU growth will no longer lead to more and more rubbish".[27] Among the strategy proposals on waste problem, the aim to develop and encourage "more sustainable

[27] http://ec.europa.eu/environment/waste/index.htm Retrieved on 25 April 2012.

consumption patterns"[28] is listed. Moreover it is stated that reduction of waste should be "the key factor in any waste management strategy"[29] .They certainly acknowledge over-consumption as a major factor behind waste problems in general. That is why "sustainable consumption and production" has been listed as one of the four policy strategies to tackle with the waste problem.[30]

In line with this aim, Sustainable Consumption and Production & Sustainable Industrial Policy Action Plan (SCP/SIP) was launched by the European Commission in 2008. Within this policy plan, especially the Ecolabel and EcoDesign programs involve actions towards electronic waste, which aim ecologically designed electronics. The goal of the action plan is to broaden the span of efforts to reduce environmental impacts to production processes and product usage as well. These efforts have been traditionally limited with treatment of waste and effluent streams and the EU targets to embrace a life cycle thinking (European Commission, 2010b). However what makes products "ecological" is most of the time their energy efficiency or whether they are made of recycled material: "Eco-friendly products should be made using recycled secondary raw materials and should avoid the use of hazardous substances. These products should consume less energy during the use phase and should be recycled once they have been discarded" (European Commission, 2010b, p.13).

Particularly because of its name (Sustainable Consumption) the policy plan appears to be a novel approach for a large mainstream institution like the EU. However a thorough reading of the related policy documents leads to a different conclusion: The focus of proposals is centered at production and there is not really any direct criticism towards the contemporary over-consumption patterns. The central question that is dealt with is *How can the environmental impacts emerging through the whole life of products – starting from production to usage and disposal – be decreased?* The question does not address anything about the consumption itself; it is still as sovereign as possible, and completely out of the target zone. By this way, the only thing that can be shaped is the environmental damage of the product (during its usage) and its production processes; but not the consumption patterns that result with more and more usage and disposal of that product. So, the unsustainability of the consumption patterns stays out of the attention zone. The outcome of this approach for waste related issues is that wasting itself is ignored. What to do with the waste and how to make it less toxic become the two main issues of interest since waste is perceived as the problem; but not the wasting that creates the unsustainable amounts of waste.

The contradiction in the EU's rhetoric on sustainable consumption emanates from the two existing approaches towards sustainability, as explained in **Section 3.1. Unquestioned Consumption**. The EU's perspective on sustainable consumption appears to be caught in the middle between these two definitions, trying to approach a balance in between and making both sides content. On one hand, the EU makes statements that show concern on wasting and aim to lead consumers "to consume responsibly or simply less" in line with the first approach towards sustainable consumption (Jackson, 2006, p.4). Documents contain self critique, with information about how the waste amounts created within the EU has been increasing and acknowledgement of how products are designed to have shorter lifespan (European Commission, 2010b). Moreover, there is clear emphasis on the role consumers can play about waste issues and environmental protection "through the choices they make when buying products" : That consumers can contribute to sustainable consumption "by considering consumption needs and choosing EU eco-labeled products" (European Commission, 2010c, p.26). However, the eco-label assessment is made by evaluating the "overall environmental performance of products" (European Commission, 2010c, p.26) and most of the time the environmental performance is calculated through the amount of resource (energy and water) spent during the production, usage

[28] Ibid.
[29] Ibid.
[30] Ibid.

and disposal of the product. Therefore, the responsibility of the consumers is to select between the alternatives for the product they want to buy and choose the one that has passed the sustainability criteria of the EU. Then, as long as they choose the eco-labeled products, whether they consume excessively or waste, may not really matter for sustainability; because sustainable consumption according to the EU means preferring products that are more resource efficient. Consequently, the suggestion for sustainable consumption becomes "consuming more of more sustainable products", which is in line with the second approach that is techno-centric (Jackson, 2006, p.4). This approach tends to see over-consumption as a matter of better technology.

The EU documents make reference to ecological interdependence as well, to create an EU-wide awareness towards waste issue and make the people and member countries of the EU realize that sustainable waste management should not be only a national policy. The improper ways of waste handling in one country can create problems that can easily diffuse to other countries; for instance "The dioxin scandal that hit Europe in 1999 illustrated how a problem in one country can affect many others(…)The crisis highlighted the need for sustainable and coordinated standards of waste management in the EU" (European Commission, 2010b, p.3). However, this ecological interdependence is limited within the borders of the EU, although it is a global concept. In the EU documents it is emphasized that if member countries are in a collective way careful with their e-waste handling based on considerations for each other, then waste will not be much of a problem. So, member countries have been acting together for the sake of their ecological interdependence at regional level. This approach might have saved the EU from the real costs of mounting e-waste but it has ended up with consequent damages emerging in other parts of the world.

Approach towards E-waste Problem: WEEE and RoHS

The EU has prepared two laws, Restriction on Hazardous Materials (RoHS) and Waste electronic and Electrical Equipment (WEEE) directives, that have become the landmarks within regulations related to electronic waste. The aim of these regulations is to reduce the usage of hazardous materials in electronic products and to create legal responsibility of the manufacturers during the whole life cycle of their products

The WEEE Directive came into force in 2003 within a broad sustainable development strategy by the EU. The directive requires each member nation to set collection, recycling and recovery targets for obsolete electronic products, and enforces responsibility for the take-back and disposal of the end-of life equipment on the original producers. This principle is known as EPR (Extended Producer Responsibility). The target is to lead companies to establish an infrastructure for taking their product back when it completes its life cycle without any extra charge on the consumer and recycle or dispose the end-of-life product under ecologically friendly conditions. The long term goal is to sustain lower risk of health and environmental damages electronics products create, no matter where and at what stage of the life cycle of the products the problems occur. Once manufacturers would be responsible from their products also after they are sold, they would be forced to redesign their products for easier recycling and with less risky and hazardous materials. Moreover, it was also predicted that the directive would push manufacturers to design longer lasting products or design for easier dismantling and recovery, which would improve reuse rates and again, result with longer lasting electronics. Consequently, the regulation would enable higher environmental and workplace safety benefits worldwide and contribute sustainability not only with decreased pollution but also by preventing wasting and making electronics longer-lived (European Commission, 2008c). That is why, the WEEE directive is a crucial legislation, with its broad approach towards e-waste issue as a sustainability problem. The long-term intentions of the directive are novel compared to many of the solution proposals on e-waste issue.

Nevertheless, whether WEEE legislation could create the impact that was aimed is disputed among scholars. The decreased rates of land-filling and incineration is explained as an outcome of the directive, but also rising global metal prices has had an impact (Lauridse & Jorgensen, 2010). In addition, only 33 percent of the WEEE within the EU is collected and treated according to the legislation and it is still not known what happens to the 54 percent (European Commission, 2008c). The directive and the actions following the directive are being criticized with "placing more emphasis on organizing a cost scheme that makes producers and importers responsible for carrying waste handling costs than on following the other objectives expressed in the WEEE directive regarding waste reduction through changed design practices for electronic products (…). WEEE is based on a top-down initiated regulatory scheme focused more on creating a new waste management regime than engaging the actors in industry and other levels in reducing waste and making electronics more sustainable" (Lauridsen & Jorgensen, 2010, p.491). Thus, charging producers for the costs of handling with the obsolete electronics did not stimulate eco-design for less waste generation as it was claimed (Gottberg et al., 2006). According to Nakajima & Vanderburg (2005), the EU could address the health and environmental aspects of e-waste problem quite well with the second directive (RoHS), but the same cannot be said for the volume aspect, which the WEEE directive was supposedly responsible with.

The RoHS Directive, which was issued in 2003, aims to gradually eliminate the usage of lead, mercury, cadmium, hexavalent chromium, and brominated flame retardants (PBBs and PBDEs) that are used particularly in certain plastics in the electronics industry. These are some of the substances which are reported to give great environmental and health damage especially at recycling or disposal processes. The directive encloses a wide range of products including various electronic goods ranging from consumer goods to medical devices, and also toys, light bulbs and sporting materials. The RoHS Directive, as indicated in the European Commission, targets only "the potential environmental risks" of substances used in electrical and electronic equipment. The European Commission has proposed a revised version of the directive in December 2008 and recently the amendments have been accepted by the European Parliament and adopted by the Council of the EU as well (Council of the European Union, 2011). The changes in the directive address for extension of the rules to more electrical appliances including cables and spare parts and promises regular review and addition of substances for the hazardous list in the future. The RoHS directive later inspired many other countries and some US. States to adopt similar legislations (Ladou & Lovegrove, 2008).

Recycling rises as top priority within the solution proposals for e-waste problem. It is frequently stated that transforming the EU into a "recycling society" is the major goal (European Commission, 2010b). Not a "minimum waste society" or a "non-consumerist society"; but recycling society is pictured as the ultimate level that can be reached for sustainability. Once every waste that is produced by societies can go back to the formal production cycle, sustainability will be achieved.
Nevertheless, in my opinion the emphasis on recycling instead of waste prevention in e-waste policies can be understood better through a reading of the recent raw materials strategy of the EU. Commission documents address that increasing prices of critical raw materials, lack of supplies, higher export restrictions by resource-rich countries create an increasing difficulty of provision of raw materials for the European industry (European Parliament, 2011). They made urgent calls for long term strategies for the raw material supply of the European industry and not surprisingly, recycling emerges as a crucial topic. To address the level of importance, it is stated that even the old landfills can be opened up for this purpose, because "if only 4 per cent of landfills hold metals and scrap materials this would already equal to millions of tones recoverable in Germany alone"(European Parliament, 2011, p.10).

A recent publication on rare earth materials addresses the urgency of developing supply strategies particularly for Europe, which is face to face with shortages of these materials in the short

term: "…the potential supply shortages and the steep increase in prices of rare earths are providing for the first time the opportunity to address the problem of today's rare earth supply in more depth and to seriously build up a recycling economy." (Öko-Institut, 2011, 110). One of the reasons for this shortage is listed as "losses of post-consumer goods by exports in developing countries" so the inefficient recycling of the waste electronics that involve rare materials in developing countries is not preferable for the EU as well, because of the strategic importance of these materials for various areas including renewable energy production (Öko-Institut, 2011, 110). Moreover, it is stressed that the strengthening of the recycling sector at the same time means creating many new jobs and contributing to the efforts against climate change. So, all the relevant actors are motivated to join the game, because from various aspects it is a ultimate win-win game.

It is difficult but not to wonder which side contributes the highest pressure − e-waste problem or the raw materials supply − for the increasing attention recycling sector takes within the EU policies. Is it the e-waste problem that is not a sufficient reason to promote the necessity of recycling so that raw material shortage and economic reasons are also included within the picture? Or is it vice versa? Analyzing whether such a relationship exists resembles to the famous chicken or egg question; for whatever the most important reason is, it seems that recycling appears to be the strategy that various related actors, especially from the business and industry environments, have agreed on.

However, the main drivers for solution efforts for the e-waste problem as a sustainability issue are triggered by economic interests rather than sustainability concerns. Because of the difficulties with mining and the geographical realities with the EU's raw material capacity and export restrictions from resource homeland countries, recycling appears to be a good option which has been neglected for some time. The costs of recycling have been dramatically higher compared to the other parts of the world due to the environmental regulations; therefore it was easier and cheaper to get rid of them through other demanding regions and countries. However, increasing difficulties with the raw material supplies for the European industry might have started to create pressure high enough to promote this sector, also as a potential solution for the e-waste problem. The second highly emphasized solution− less toxics− makes the economic plausibility and attractiveness of the recycling sector only higher: As long as e-waste is less hazardous, then its recycling would be less costly and relatively easier. These two solution proposals for the e-waste problem create a perfect picture for especially to take the support of the actors from the business and industry.

4.4. Greenpeace

Since 2005, Greenpeace has been actively working on e-waste problem and produced various publications on the issue. Moreover, it is one of the first global organizations that called for attention from the global community for e-waste trade, documenting the working conditions of the informal e-waste handling sites in Africa and China. In August 2005, they published a report on the environmental pollution and health damages e-waste recycling workers face in India and China.[31] This report was one of the first works that documented the e-waste problem in the developing world, which was mostly unseen to the international public until then.

[31] http://www.greenpeace.org/international/en/campaigns/toxics/electronics/Campaign-timeline/ Retrieved on 4 May 2012.

Framing: E-waste only as a Pollution Problem

The first impression one can get from the Greenpeace International website on their work on e-waste is that they frame the problem within the boundaries of hazardous materials and toxic pollution. The e-waste issue is placed under the "Toxic Pollution" tab on the Greenpeace International website and the campaign on the e-waste issue is named "Greener Electronics". The health and environmental aspects of the e-waste problem is highlighted much more than the volume and the trans-boundary movement problems. In line with this framing, the main target of Greenpeace e-waste campaign is multinational electronics companies. The website and publications aim to create public pressure on electronics companies to change the toxic materials they use for the manufacturing of their products and choose for "greener materials". So they propose that producers should take full responsibility of the e-waste problem; initially prevent the toxic effects of their products at their end-of life and secondly be fully responsible for the recycling of their obsolete products. In August 2006, Greenpeace launched the first version of their "Guide to Greener Electronics", a report ranking well-known electronic companies for their efforts on these two issues. The aim of ranking is to benefit from the highly competitive nature of the electronics industry and create a pressure through influencing consumers with their buying preferences based on the environmental consciousness of electronic companies. Greenpeace asserts that, through charging the whole responsibility on the producers, they will be pressured to develop ecologically designed products and by this way e-waste problem will be prevented "at source". (Greenpeace, 2008, p. 10).

Although many of their reports on e-waste issue include statistics and forecasts on the amount of electronic waste being produced at different parts of the world, the focus of Greenpeace seems to be fixed on the toxic impacts of the electronic waste and improper recycling. There is hardly any research or statement on the consumption side of the issue and what can be done to tackle with it. On that sense, it seems a bit contradictory to ignore the volume aspect of the issue in spite of all the data given in their reports. The approach of Greenpeace creates an impression on the reader, that as if the toxic character of electronic products can be reduced, e-waste will not be a problem anymore in spite of the mounting volumes. Apparently, Greenpeace does not perceive the over-consumption of electronics as a problem: As long as the e-waste can be recycled without any toxic impact, all the other negative outcomes related to resource consumption and increasing throughput will not be as crucial as the pollution that informal e-waste handling has been creating. So, once electronic products are made from "green" materials − aka non toxic − and electronics become green, we will not be speaking of a wasting problem with the current electronics industry.

However, this perspective on e-waste contradicts the very core of the issue, starting from what waste actually means. According to Oxford English Dictionary, the verb (to) waste is defined as "to use more of something than is necessary or useful" [32], while the noun waste has two definitions, the first one being " the act of using something in a careless or unnecessary way, causing it to be lost or destroyed" and the second meaning "materials that are no longer needed and are thrown away"[33]. The rhetoric of Greenpeace shows that they embrace only the second meaning for e-waste and accept that electronic products become obsolete only because they are no longer needed and that is when they are thrown away.

Questioning the necessity and usefulness of our consumption patterns is fundamental to understanding sustainability problems. Evaluating e-waste problem only from a toxic pollution perspective contradicts the mission of Greenpeace as an NGO struggling against climate change as well. The problem is not only an issue of waste as defined to be materials which are no longer needed

[32] http://oald8.oxfordlearnersdictionaries.com/dictionary/waste_1 Retrieved on 10 May 2012.
[33] http://oald8.oxfordlearnersdictionaries.com/dictionary/waste_2 Retrieved on 10 May 2012.

and useful, but also it is an issue about wasting, that necessitates questioning whether the way we consume and dispose electronics more than necessary or useful. It was not only the toxic materials released to the atmosphere and the environment that created negative impact on the climate. Also and most importantly the way the resources of the planet have been used to support the production and consumption patterns of the modern throw-away societies have resulted with the climate change symptoms of today. Even if direct pollution created by the manufacturing processes is eliminated, over-consumption and its indirect consequences will continue to become a burden on the planet in the long term.

Individual Producer Responsibility: Polluter is safe once costs are paid?

Although not emphasized as much and strongly as toxic pollution, Individual Producer Responsibility (IPR) is another program started by Greenpeace on the e-waste issue. The basic idea of this program is that companies should be responsible from the take back, recycling and reuse of the company's own branded products. They defend that the handling of e-waste stream must be solely the responsibility of producers, in contrast to the traditional recycling programs where local governments and taxpayers pay the cost for collection and recycling of disposed products (Greenpeace, 2007a). The only role consumers can play is to make sure that products they discard will be collected separately from other waste. For governments the role is to make laws and regulations to ensure environmentally suitable recycling standards.

The organization states that they at least expect financial responsibility from the companies with their own branded obsolete products because "physical responsibility is not always feasible and could result in duplicated infrastructures e.g. for waste-collection (Greenpeace, 2011c, p.4). However the latest Greenpeace documents on IPR are from 2007 (Greenpeace, 2007a); for 5 years the organization has not produced anything on their IPR proposal compared to the Green Electronics campaign which has frequent documentation recently. This also shows that the priority has been given to the Green Electronics campaign, therefore to toxic pollution aspect e-waste issue.

The reason why Greenpeace names its program Individual Producer Responsibility is that they believe Extended Producer Responsibility (EPR) is inadequate with leading manufacturers towards more ecologically friendly design of their products. By making companies each individually responsible with the end of life costs, Greenpeace aims to create competition between companies and promote innovation through the direct advantages companies can gain by transforming their manufactures. Otherwise, EPR makes all producers pay same costs for a single and combined collection and recycling system, whether they improve and redesign their products or not (Greenpeace, 2007a). However, the main objective of this program appears to be to direct companies to "eco-design", that is to make them redesign their products "to be more recyclable and less toxic" (Greenpeace, 2007a, p.6). There is no emphasis on the importance of producers designing longer lasting products. Without any specific discussions about planned obsolescence and how it contributes to the mounting amounts of e-waste, IPR seems to be a program designed only to make companies pay the direct costs of dealing with the waste of their products. Thus, the approach of Greenpeace towards e-waste problem lacks long term resource concerns e-waste can create.

From sustainability and climate change perspective, Greenpeace started a separate campaign called "Cool IT Challenge" in April 2009, which aims to pressure electronic companies to use renewable energy and evaluates the world famous electronics brands according to the proportion of renewable energy within their whole energy consumption. The focus of this campaign is on the energy usage characteristics of the IT sector and whether they show any effort to reduce their own greenhouse gas emissions. Also, whether companies develop more energy efficient product models is a criterion within the Cool IT Challenge of Greenpeace. However, the real emphasis of the program is

to evaluate whether big IT companies like Google or Amazon are choosing renewable energy resources to supply their energy intensive activities managing the data exchange. Consequences of electronics consumption patterns and e-waste on sustainability have not been included within the climate change analysis and campaign of Greenpeace as well.

Greenpeace and E-waste Trade

Finally, the organization has published several reports about pollution and toxic chemicals around e-waste recycling and disposal sites in countries like Ghana and Pakistan. With these reports, they aim to take global attention to the hazardous conditions of e-waste processing in developing countries. However, within the policy programs of Greenpeace, there is no direct campaign targeting e-waste trade or global regulations on e-waste transportation (for instance, the Basel Convention). The organization has determined electronics companies as the only responsible agent in e-waste issue and their campaigns aim to impact these agents for the elimination of toxic chemicals from their products. This is done by providing people with various reports about the steps companies have taken for less toxic products, and with charts that show the rankings of companies according to how "green" their processes are. It can be argued that by the significant emphasis on the pollution issue, Greenpeace aims to tackle with the most visible damage e-waste problem creates on environment and human health. Once this problem is eliminated, e-waste trade or improper recycling will be less of an issue, since direct negative consequences are removed away. However, even if this is the goal, an unbalanced weight on the environmental and health hazards can create a distorted picture of e-waste problem, particularly overlooking the factors and mechanisms creating the overconsumption of electronics. For instance, if toxicity is the only problem with waste issues, then food waste would not be considered as a problem at all, since it creates hardly any toxic hazards on nature. Consequently, although Greenpeace criticizes electronics companies strongly and directly with concrete pressure campaigns, the critique comes from a limited framing of the e-waste problem and does not target all aspects.

4.5. US-EPA

USA is frequently criticized with the absence of related laws and legislations on the electronic waste issue (Ladou & Lovegrove, 2008). There is consensus among the studies on the policy comparisons between countries that "..government policies regulating e-waste in the United States lag conspicuously behind those in Europe and Japan" (Grossman, 2006, p.8).Until the time of writing this thesis, USA was still among those few countries which had not ratified the Basel Convention yet. The absence of laws is not only in international matters; some scholars have already examined the lack of federal regulations and the discrepancy between regulations of different states (Gibson&Kundman-Tierney, 2006; Renckens, 2008). In contrast to this attitude which might appear to be negligence of the issue, the United States Environmental Protection Agency (EPA) has produced quite a number of policy proposals since mid 1990s.

Reduction Target Ignored

One of the most significant characteristics of the approach of EPA towards the electronic waste issue is that in none of the documents, planned obsolescence and the shortening life spans of electronics. This is not a surprising finding, as this fact is hardly pointed out in other institutional documents as well. Even if it is described as a serious cause of the problem and needs to be tackled, hardly any proposals are designed to address it, as the discourse analysis of the EU has shown for

instance. However, what distinguishes EPA approach from the EU approach is that, the shortening lives of electronic products are not mentioned at all, let alone any solutions addressing it. By ignoring this fact, EPA also chooses to divert from the traditional 3R Waste Management Hierarchy (Reduce, Reuse, Recycle) towards eliminating any waste problem. According to 3R, waste management strategies should start with aiming to reduce the creation of waste. If this is done, reuse possibilities should be developed. The final step should be the recycling option (Kazuma, 2008). The EPA discourse takes the source of waste out of the picture; the only strategy that is considered is what to do with that waste that emerges from "somewhere". Reuse and recycle is proposed to be the two strategies for reducing or preventing e-waste (EPA, 2001), although they are actually the following steps once concrete actions to reduce the emergence of e-waste is taken. Reuse and recycle are not methods to reduce e-waste waste hierarchy. Once everything that is possible is done to reduce e-waste, you can aim to continue with the following two steps. However, EPA's attitude towards not including the root cause of the volume aspect pushes the institution also jump off the reduction step of the waste hierarchy.

Resistance against State Regulation: Voluntary Participation for Change

Different than the approach of EU and the Greenpeace for instance, which claim major responsibility on the electronics industry, EPA does not attribute any specific burden on any of the related actors. It is particularly avoided to make strong claims about the policies of the industry, or the consumption patterns of the consumers. As Barack Obama also states in his proclamation letter on the America Recycles Day in 2010, "to address problems caused by electronic waste, American businesses, government and individuals must work together" (Obama, 2010). More importantly, all the contribution from these actors will be on voluntary basis and government does not have any coercive power or strategy to push agents change their approach on e-waste. That is why, in an indirect way, the only responsible actor becomes the government itself and the documents of the EPA actually addresses the steps only the government can take, to motivate other related actors. "Promote, motivate, advertise, provide, support" are frequently used words while explaining what governmental agencies can do to persuade other agents into "partnerships" with the government to tackle with the e-waste problem (EPA, 2011a).

Since EPA as a governmental institution particularly refrains from claiming any responsible actors or polluters, different than the approaches of Greenpeace and the EU, recycling is not accepted as a responsibility of the electronics manufacturers. What is expected from the industry is to support "responsible recycling"[34]. There are many refurbishers, collectors and recyclers; however if they have the certification from the government, then it means they do their recycling responsibly and they could be trusted. However, these certification programs are voluntary and more importantly, what is exactly meant with responsible recycling might be quite limited within the boundaries of the US, because of resistant attitude of the US against international regulations controlling the e-waste traffics (Andrews, 2009). According to the guide for National Strategy for Electronics Stewardship, "Quality electronics recycling certification programs not only advance best management practices, but also offer a way to assess the environmental, worker health and safety, and security practices of entities handling used electronics" (EPA, 2011a, p.21). Based on this explanation, it could be very much possible to have a US recycling facility that collects used electronics under suitable conditions and sends them to a facility in a developing country, with the promise that they will be recycled according to the best environmental and health considerations. So under this certification program, the recycling

[34] http://www.epa.gov/epawaste/conserve/smm/electronics/index.htm Retrieved on 15 May 2012.

practice can achieve to be responsible for its labor, customers and the environment within the US, but what would happen outside of the borders is not within its responsibility.

Recycling is not only important to preserve materials and contribute to the sustainability of the Earth, but also and specifically for developing "the billion-dollar industry" and creating many more jobs; thus contributing to economic growth (Obama, 2010). Including Barack Obama's letter that calls for action from all the related parties for the e-waste problem, majority of EPA documents emphasize that recycling should not only be seen as an extra burden or responsibility only for the sake of the environment and sustainability, but it is actually an important sector that will bring economic growth and jobs like a production facility. So in the end, in economic terms recycling will not cost at all; in contrast, in conventional economic terms it will bring benefits.

No Limits on E-waste Trade

An important point about the US approach towards e-waste trade is that it is specifically refrained from speaking about any limitations on exports. USA is one of the few countries that still has not ratified the Basel Convention, that brings certain limitations on the trade of hazardous substances, including e-waste. The only regulation proposal is on governing the export of the cathode ray tubes (CRT) from used computer monitors and televisions (EPA, 2011a). Although various hazardous materials that are inside the used electronics are listed within their documents and by this way it is accepted that CRTS are not the only harmful contents, there is no word on export regulations for other hazardous materials.

A full acceptance of the responsibility for the damage their exports create in other countries would be to take the necessary steps to change the dynamics that enable the exports on the US side, which is under the authority of US governance. However, instead, EPA chooses to offer technical assistance for the recipient countries and suggests establishing partnerships to help them better manage used electronics (EPA, 2011a), or in other terms the US e-waste exports. However, this strongly contradicts another target of the government: to develop the domestic handling of the used electronics. As long as legitimate and cheaper alternatives exist outside the US, how can US develop its domestic management capacity?

A significant point that needs attention is that, in spite of this well-known resistance of the US towards the export regulations and the Basel Convention, in the recently started Electronics Stewardship, it is stated that US aims for "strengthening its participation in the Basel Convention, including options that would enable ratification" (EPA, 2011a, p.30). Nevertheless, the main intention is not necessarily to regulate the traffics completely, including possible bans; but to have influential power on the discussions to determine the classifications of used electronics and their trade. As an observer at the moment, the US lacks this power, according to EPA. However, when and how the US aims to ratify the Basel Convention is not stated, so the target is rather vague. Also, researchers state that in the near future the US is not expected to change this attitude against the Convention significantly, because the country lacks recycling infrastructures for many types of e-waste (Tonetti, 2007).

US reluctance to interfere with waste electronics trade can be seen in some non-EPA documents more explicitly. For instance, the Basel Convention draft document on the technical guidelines for the trans-boundary movement of electronic waste and second hand electronics reveal the comments from various participants that propose certain changes on the document. The comments from the US side particularly reveal a cautious approach to controlling and limiting the trade completely. They ask for more stress for the distinction between the trade of used electronics and e-waste and propose that the document should include statements that the Convention guidelines will "facilitate trans-boundary movement of used electronics" (Basel Convention, 2012b, p.4). Moreover,

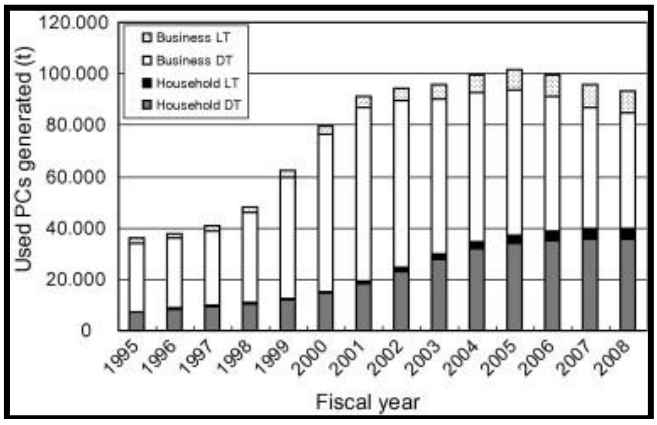
they ask for modifications to include the demand drivers of the e-waste trade, and to decrease the responsibilities on the exporters for control and limiting of the trade. They indicate that these responsibilities should be under the hands of the importers. By this way, the US comments neglect the interconnectedness of sustainability and highlight the sole economic rationale behind the free trade paradigm − even if they are harmful. They stress that as long as demand exists from the importer side, exporter should not be bounded with responsibilities other than economic interests. Moreover with this approach, it is ignored that exporter countries and importer countries of e-waste have a huge gap between the quality and implementation strength of their legal systems and their publics have even wider gap on environmental awareness. Importer countries are unrealistically expected to have even higher consciousness and a proactive attitude on the hazardous trades of e-waste, although responsibilities should be equal in both sides.

As a result of the avoidance of EPA to make certain concrete claims that will result with regulatory interference, the content of the US e-waste policy inevitably becomes vague. Used electronics should be handled responsibly; e-waste should be managed in safe and effective ways; electronics should be designed green; the damage that the US exports can create must be minimized. How these can be achieved if adopting these principles is completely on a voluntary basis still remains a huge problem with the US policy. In the end, it is all in the hands of the industry to comply with the suggestions of the government or not.

4.6. Japan

Japan has one of the highest consumption rates for electronics, as the country is named "gadget-obsessed" frequently, to describe the rocket high volumes of electronics sales in the country.[35] These rates reflect on the e-waste volumes as well; as various resources claim that Japan has the highest volumes of e-waste in Asia and is one of the important suppliers of e-waste for the informal recycling hubs. The approach of Japan can have significant effect on the issue. For this reason, it is important to include an analysis of the Japanese policy approach towards the e-waste issue.

Figure 14: Number of used PCs in Japan, FY1995–2008. Notes: DT: desktop PC; LT: laptop. (Source: Yoshida et al., 2009).



[35] http://www.cnngo.com/tokyo/shop/urban-mining-finding-value-amongst-old-electronics-464333 Retrieved on 15 May 2012.

Lack of E-waste Policy Documents in English

The Japanese Ministry of Environment is the highest responsible institution on environmental matters, including e-waste. However, it is not very easy to draw a picture of the Japanese governmental approach towards the problem, as the English version of the ministry's webpage is not very up-to-date and not all policy documents are available. General documents such as annual reports on Japanese environmental policy and sustainability strategies etc. can be found on the webpage in addition to some of the legislative documentation. However specific documents on different policy areas are not available. Therefore, the quality and content of this analysis will be limited as directly related resources are not available in English. Nevertheless, I believe that the general approach towards sustainability and environmental matters can still give an idea about the approach towards e-waste as well. It should also be noted, that the absence of policy documents prepared in English on the e-waste issue creates a visible absence of analysis on Japanese policy in the international literature. Compared to the number of studies on US and EU policy, research on Japan seems limited, and the few articles are written by Japanese scholars.

Japan has two laws on e-waste (recycling) that were adopted in 2001. The Home Appliance Recycling Law is on the recycling of TVs, washing machines and air conditioners. The second one, the Law for Promotion of Effective Utilization of Resources is a more general legislation and is about eco-design of products for recycling. Accordingly, computer manufacturers are required to design their products in line with the 3R principle. They are responsible from collection and recycling of computers from businesses and households (Ministry of the Environment Government of Japan (2001a, 2001b). Consumers need to pay certain fees for their obsolete electronics for this service; that is why scholars argue that these laws have not really created an impact on the manufacturers to modify the design of their products in line with ecological considerations (Ladou & Lovegrove, 2008). In addition to these legislations, there is a third law which is related to e-waste trade. Law for the Control of Export, Import & Others of Specified Hazardous Wastes and Other Wastes was issued at the end of 1992, to harmonize the domestic rules on waste export and import with the Basel Convention.

Japan and the West: Cultural Differences on Sustainability Approaches

The discussions in the documents are not purely technical and policy related; different than the discourses of the other governmental institutions the Japanese ministry includes relevant ethical arguments as well. Sustainability issues are evaluated within a broader approach and are linked to a discussion of the contemporary economic growth. Ministry questions whether the way economic growth has been defined really reflects the qualitative aspects of the human well being and happiness. In an indirect manner, the difference of the Japanese approach from the Western understanding of the nature is underlined, in a way connecting the sustainability discussions to the Japanese culture, which rejects the Western perception of the nature as something to be conquered (Ministry of the Environment Government of Japan, 2010a). For a better understanding of the sustainability problems the world faces today, Japan chooses to base its strategy on its own culture. According to the ministry, it already addresses certain values that the world is discovering recently as they face the severity of the environmental issues. Appreciating the nature and living in harmony with it, understanding the capacity of the nature and shaping the strategic decisions about sustainability issues based on knowledge provided from the dynamics of the ecosystems are among the basic suggestions brought by the Japanese Ministry of Environment for the sustainability approach of the country (Ministry of the Environment Government of Japan (2010b).

Need for a New Growth Strategy: "A Sound Material-Cycle Society"

On the other hand, together with these discussions that have a strong cultural basis in my opinion, the ministry also adds comments about how it is now impossible for modern societies to go back to the primitive sustainable society these cultural underpinnings would address. Back then, in ancient times regeneration and self-purification were enough to compensate the environmental impact created by human activities; however modern societies are at a level that is irreversible to that point. That is why Japan proposes a new growth strategy that will involve the necessary changes in business styles and life styles of people in line with the Japanese values on nature and ecosystems. This strategy will take into account the realities of the modern societies. This new growth strategy aims to create "a Sound Material-Cycle Society" that is based on an efficient implementation of the 3R principle (Ministry of Environment, 2006).

Japan's approach towards sustainability issues and especially waste problems is addressed generally under these Sound Material-Cycle Society strategies. The Ministry has published large and detailed reports about these strategies; on how to improve resource and recycling efficiency, and waste prevention. Compared to EPA documents for instance, Japan policy reports are much more concrete, involving empirical research and various examples from implemented solutions. Efficiency of material cycles is researched in various fields, ranging from food to textile. In contrast to the EPA discourse for instance, the importance of longer life products for sustainability is mentioned. However, this is done in a generalist way; electronics is not addressed specifically.

International Cooperation or Resistance to Trade Bans?

The Ministry states frequently, that the desire for transformation towards a sound material-cycle society is not limited only to Japan; they aim to lead the world for a global transformation starting from their neighboring regions. That is why; they have already initiated several projects with the neighbor countries like Bangladesh, China and Vietnam, for further bilateral cooperation and partnerships on sustainability and 3R strategy. With countries like China and Korea, annual Waste Recycling Policy Dialogue meetings are organized to discuss possibilities for "concrete cooperation on proper management of electrical and electronic wastes, medical wastes, etc. and import/export management of wastes" (Ministry of the Environment, 2010, p.75). In line with its international approach especially in the Asia-Pacific region, Japan has led the Environmentally Sound Management of E-waste in the Asia Pacific Region initiative. Underneath this strong emphasis on international cooperation particularly in the East Asia, Japan's strong resistance towards bans on e-waste trade lies. Japan is among the states that have not accepted the Basel Convention amendment that fully bans the export of all forms of toxic wastes for any reason from developed to developing countries. Moreover, Japan participates in lobby activities with US, Canada and South Korea against the possible enforcement of the amendment (Puckett et al., 2002). However, the discourse of the Japanese policy documents hides the existence of such a resistance. There is frequent emphasis on the importance of regional and international cooperation for better waste management, and the necessity to construct bilateral relationships to on import/export of hazardous waste and their treatment (Ministry of the Environment 2006, 2008, 2010). Like US, Japan emphasizes the willingness of Japan to assist and support the e-waste recipient countries to develop their e-waste handling systems.

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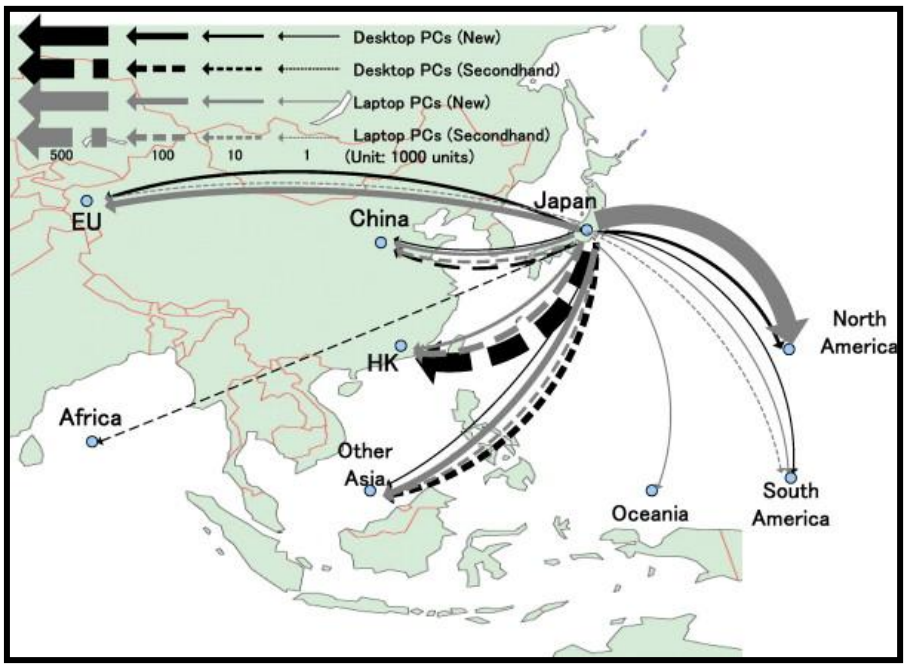
Figure 15: Destination of secondhand PCs exported from Japan in 2004 (Source: Yoshida et al., 2009).



4.7. StEP Initiative

The Solving the E-waste Problem Initiative (StEP) was started at the end of 2004 after a book project by the United Nations University (UNU) on computers and the environment. The organization was formally launched in March 2007. The book project created a realization of the further questions that needs attention on the e-waste issue and led to this international initiative, that consists of more than 50 actors from electronics and recycling industries, academia and NGOs. Hewlett Packard, Dell, Korea Institute of Geoscience and Mineral Resources (KIGAM), Delft University of Technology in the Netherlands, United Nations Conference on Trade and Development (UNCTAD) , United Nations Environment Program / Division of Technology, Industry and Economics (UNEP/DTIE) are a few of the members from different fields.

As Inclusive As Claimed?

The variety of the members and their varying interests makes StEP Initiative an interesting organization to evaluate for its position on e-waste. Because of the multi-dimensional and international nature of the issue, there are various stakeholders that are directly or indirectly affected by the problem. Electronics manufacturing companies, recycling companies, e-waste traders, governments, electronics consumers, formal or informal e-waste recycling labor, people living in and around the informal e-waste hubs, the nature in these regions are all affected in different terms. The StEP Initiative appears to be a strong mix, bringing together different names from the ranging spectrum of stakeholders. However, once carefully looked through the profiles of the members[36], the absence of environmental protection NGOs becomes quite noticeable. There are environmental and ecological research institutions present; but none of the members including these institutions fully represent the interests of the nature as a stakeholder of the issue. Moreover, non-governmental

[36] http://www.step-initiative.org/index.php/Actors_Members.html Retrieved on 16 May 2012.

organizations like Basel Action Network[37] or the Silicon Valley Toxics Coalition[38], which have radical voices on the e-waste issue (asking for full ban on any forms of hazardous waste exports from the developed countries or highly critical of the planned obsolescence strategy of the electronics industry), are also not included in the initiative. Although one of the main principles of the organization is to create a multi-actor environment for a "comprehensive view of the social, environmental and economic aspects of e-waste"[39], it is questionable whether the organization can fully comply with this principle and create a democratic arena for stakeholder dialogue as certain voices are left outside.

The organizational structure of the initiative, including its units for research and policy development, is very clear, therefore the areas of action StEP determines for itself on the e-waste issue is not confusing. However, the inclusion of various actors within the initiative that have contradicting interests makes it relatively complex for the organization to determine a concrete standpoint for itself, like Greenpeace for instance. This could particularly be traced to the publications of the organization. In line with its aim to create a standpoint that is "neutral and scientific-based"[40] for dialogue, analysis and developing solutions for the e-waste problem, most of the documents of the StEP consist of analysis reports prepared by scholars from different universities. These publications are in general technical assessments of the e-waste situation and management in developing countries, like Uganda, Kenya, and Morocco etc. In these documents, barriers for the transfer and implementation of sustainable e-waste recycling technologies are determined, which are mostly related to weak legislations and lack of political willingness, lack of technology, lack of financing in these countries according to the organization (StEP, 2009). So in a way, it is defended that 'the e-waste problem of poor countries' can be solved by giving them better technology.

In addition to these reports, StEP has two other types of documents: 1. White papers which "reflect a common StEP standpoint"[41] 2. Green papers which share research findings in line with the core principles and objectives of StEP, but "do not necessarily reflect an agreed standpoint by all the members of the organization."[42] as indicated by the organization. For the sake of dialogue between different opinions, it is important to involve various voices, however this situation contradicts with StEP's own proclaimed target to have a certain attitude towards the e-waste issue.

Reduction Target Excluded

StEP has tried to include all aspects of the e-waste problem; therefore the research areas of the organization include international aspects and legislations of e-waste trade, global solutions for better redesign, recycling and reuse; as well as regional circumstances of particularly developing countries on e-waste management. Thus, StEP has certainly a comprehensive approach towards the e-waste problem. The proposals brought under the "Redesign" research division involve measures towards improving obsolescence rates of electronics that can result with reduced electronics consumption volumes. The suggested design modifications, such as life time extension, recovery of components for reuse are against the planned obsolescence strategy of the electronics industry. Therefore, it can be said that the discourse of StEP significantly differentiates from the discourses of the organizations that have been analyzed so far.

[37] http://www.ban.org/ Retrieved on 17 May 2012.
[38] http://svtc.org/ Retrieved on 17 May 2012.
[39] http://www.step-initiative.org/index.php/Initiative_Principles.html Retrieved on 17 May 2012.
[40] Ibid.
[41] http://www.step-initiative.org/index.php/Publications.html Retrieved on 18 May 2012.
[42] Ibid.

However, although the target is to reduce the amount of e-waste generation by these strategies, StEP skips the Reduce step of the 3R hierarchy (similar to the discourse of EPA) and names it Redesign instead. In my opinion, the absence of an explicit Reduce step in the e-waste management strategies proposed by StEP can have political reasons rooted in the stakeholder nature of the platform: The membership and support of important electronics manufacturers might be creating a certain pressure on the discourse that softens the language. For instance, it should not be a coincidence that an analysis paper on scarce metals and their future, which ends up with these final comments calling for a regulation on the electronics industry, finds itself labeled as a green (aka. "not agreed by StEP") paper: "The LCD screens and high-tech gadgets in which the majority of indium is used today will be probably broken or obsolete within several decades. Technological advances, recycling and material substitution are beneficial, yet by leaving the problem predominantly to market forces in the absence of a policy response, we are potentially limiting the security of supply of critical metals to future generations." (StEP, 2012, p.32).

As the final conclusion the significant difference of StEP's rhetoric compared to the other institutions' discourse should be highlighted. Although content-wise documents do not match with it yet, the future vision statement of the organization is certainly distinct from the mainstream approach towards e-waste. Accordingly,

> "StEP envisions a future in which societies have reduced to a sustainable level the e-waste related burden on the eco-system that results from the design, production, use and disposal of electrical and electronic equipment. These societies make prudent use of lifetime extension strategies in which products and components – and the resources contained in them – become raw material for new products." (StEP, 2012b, p.3).

In my opinion, these statements places StEP in a different place on e-waste policy-making. If they can develop policies in line with the promises of this vision, the organization will indeed target the birth place of the e-waste problem.

4.8. Basel Convention

As a result of the public outrage that toxic waste imports have created in global community, the United Nations Governing Council initiated negotiations to prepare a global convention on trans-boundary traffic of hazardous waste. This ended up with 118 nations signing the Basel Convention on the Control of Trans-boundary Movements of Hazardous Waste and their Disposal (known simply as the Basel Convention) in 1989. The aim of the Convention was to control the amount and international flow of (especially dangerous) waste and promote their domestic processing. The Convention entered into force on 5 May 1992 and as of May 2012; there are 179 parties to the Convention, with three countries − Afghanistan, Haiti and the United States that have not ratified it yet.[43] The trade of hazardous waste is allowed only under the following circumstances:

1. If the exporting country does not have sufficient capacity for disposal.
2. If the exporting country does not have capabilities and disposal sites to dispose waste in an environmentally sound style.
3. If the waste that is traded is required as a raw material for recycling or recovery industries in the importing country.

[43] http://www.basel.int/Countries/StatusofRatifications/PartiesSignatories/tabid/1290/Default.aspx Retrieved on 20 May 2012.

The Convention does not ban the trade of export and import of e-waste at the moment. The preference to use the word 'control' instead of 'ban' or 'prevention' shows that the aim of this initiative was not really to stop the hazardous waste trade, but to monitor it in formal terms. Only the ban of exports to Antarctica is an exception to this approach. For the Antarctica continent a full ban from all regions was proposed.

Research has shown that although the Convention proved to be effective in reducing the trading of hazardous waste for final disposal, there has been a rapid increase in the exports of waste for reuse and recycle (Shinkuma & Huong, 2009). Since the Convention does not ban the transfer of equipment for direct reuse purposes, this means if a container is filled with PCs which are reported to be second hand and working, then the container can easily pass the borders. However, inspection reports show that a big proportion of the PCs sent under these conditions are already not working on time of arrival and therefore they are considered as junk (BAN, 2002). Moreover, it appeared that trade for recycling can be as harmful for the environment as trade for disposal and that the Convention did not have the measures that could successfully target these newly arising problems. Scholars have raised concerns over manipulative attempts from different actors on categorization of hazardous and non-hazardous waste in line with pure economic interests. For instance Kimani (2009), depending on information from Greenpeace, claims that "it was industry's strategy to call all recyclables non-waste or secondary raw material instead of waste. By doing this, the industry hoped it will be able to perform a Houdini-like escape from the huge body of existing legislation both national and international, (including the Basel Convention) which all make reference to the term waste"(p.56).

These developments led to the adoption of the Basel Ban Amendment on 22 September 1995, with 73 countries ratifying. The amendment bans the export of dangerous waste from 29 OECD members to all non-OECD countries completely (including recycling and disposal purposes). The ban still could not be implemented yet, because there is a continuing dispute about the exact number of countries that is needed to accept the change so that it can become enforceable. Moreover, an interesting feature of the amendment as criticized by Lepawsky and Mcnabb (2010) is that the amendment tries to ban the trans-boundary e-waste traffic between Annex VII (developed countries) and non-Annex VII (developing countries) countries; but does not bring any regulations for the traffic between non-Annex VII countries. The non-Annex VII countries list includes countries such as India, China, and Kenya. By this way, developing countries are treated as a homogenous block with their quite different economic, social and technological dynamics. As Lepawsky and Mcnabb (2010) claim, this means "India, China. Bangladesh and Kenya are framed as equally underprivileged and vulnerable in relation to trans-boundary flows of hazardous waste from developed countries, but not in relation to such flows between themselves or other developing countries"(p.179).

Paradigm Shift towards Seeing Waste as a Resource

According to the Basel Convention Non-Paper issued in February 2011, SBC has decided to embrace a more comprehensive attitude about waste related problems, instead of the specific focus that was adopted only on regulations and legal dimensions of waste transportation until recently (Basel Convention, 2011f). I believe this is because SBC has also started to acknowledge that current efforts to control the international traffic of toxic waste is not enough and a wider approach is necessary to understand the dynamics that create trans-boundary flows. The paper accepts that "despite the over-arching objective to minimize the generation and trans-boundary movements of hazardous and other wastes, at the global level the volume of hazardous waste which is produced and transported across borders is increasing". It is declared that the Basel Secretary will start supporting the efforts related to "the issue of resource management, through promoting a lifecycle approach which incorporates economic, social and environmental sustainability; in addition to the activities on

the environmentally sound management (ESM) of hazardous and other waste" (Basel Convention, 2011f). Consequently, waste management should not be seen only as the best techniques and methods to foster efficient disposal. It should be perceived as creating new uses, resources and values. With this document, the Secretary declares that it will no longer adopt the linear perspective for waste, according to which the value transformation from product to waste is single directional, from value to non-value. Evidently, SBC is calling for a change in the attitude towards the value of waste in throw-away societies and trying to include waste back to the production cycle again as an input.

The proposed paradigm shift by the Basel Secretary has important positive aspects such as initiating an intergovernmental motivation for the first time to change perceptions especially in the developed world about waste. This can imply that the SBC believes that if developed countries also see waste as an important resource, the traffic of waste from the developed world to the developing world would stop. Also, it shows that according to the Secretary if waste enters back into the production cycle, the volume related problems of waste can be solved. Actually, the e-waste exports to the developing countries means that e-waste has already been entering back into the production chain; however this transformation was enabled by informal chains and actors; and the profit of this transformation was flowing to informal actors. I believe the call by the Basel Secretary also reflects an enthusiasm especially from the formal participants of the techno-economic system to have a share from this profit.

On the other hand, a detailed reading of the documents shows that the focus of intervention is the informal agents in developing countries, which already perceive waste as resource and transform it into new forms of value. As it is stated in one of the reports of the Basel Secretary, the change in the approach of the Secretary "will require a shift from an inward focus on the Secretariat to an outward focus – how can technical assistance, technology transfer and capacity building be strengthened at the global and regional levels and how to build synergies in the delivery of those services to countries that need it the most?"(Basel Convention, 2012a, p.2)." So, although waste is perceived as valueless in developed countries and that is why it is exported to places where there is demand for it as resource, the Convention Secretary aims to make "the paradigm shift" call in regions where the paradigm is actually already 'shifted'.

Particular Attention to E-waste

Since 2002, e-waste has been accepted as a priority issue by the authorized bodies of the Convention. With the Nairobi Declaration on the Environmentally Sound Management of Electrical and Electronic Waste, which was adopted in 2006, the authorized bodies of the Convention were given a mandate to develop and implement programs specific for e-waste problem.

E-waste, as one of the waste types which has a high potential for re-use and recycling, is certainly affected from the changing attitude of the SBC. In line with the discourse of the Secretary on shifting paradigms, it is not only the international traffic of e-waste that is targeted; to achieve environmentally sound management of e-waste has become a major goal for the SBC, as stated by the Executive Secretary Jim Willis (Basel Convention, 2012a). New projects particularly for the Asia-Pacific and Africa regions have been initiated, with a focus on environmentally sound management of e-waste in these regions. The documents of these projects indicate that a consensus has been reached for a global solution of the e-waste problem: to create a global division of labor to manage the increasing amounts of e-waste in line with the global dynamics of used electronics and raw materials supply and demand. There is hardly any emphasis on the reasons why so much e-waste is being produced and what can be done to reduce its production.

A Global Division of Labor for the Solution of the E-waste Problem

The proposal of the Basel Convention for e-waste issue can be explained as follows: The first step is to develop a solution for the increasing amounts of discarded electronics. The demand for cheap electronics from the developing countries is obvious. Also and more importantly, the supply of used electronics is rapidly increasing in the developed countries, where people change their electronics much more frequently. These second hand electronics are not necessarily in complete waste conditions. Mostly because they are not up-to-date with their software, or not fashionable enough, or because it is very costly to repair them for their minor problems, they are discarded.[44] The supply of used electronics in developed countries and the demand for cheap electronics will be balanced by a free trade of used electronics. Only when the electronics is in waste condition, trade can and 'should be' forbidden (Basel Convention, 2012a) but this is the case only for the trade from OECD to non-OECD countries.

The promotion of trade of second hand electronics to poor countries, especially in the African continent, will not only meet the demand of the African people for cheap electronics, but will also create many jobs in refurbishment and repair sector (Basel Convention, 2011b; 2011d). More importantly with this solution, the ICT gap between the developed and developing world will also be closed (Basel Convention, 2011b). So developing countries will double their benefits from this deal. Developed countries will provide technical support and technology transfer to developing countries for this purpose.

The second step is to develop a recycling solution that will comply with the raw material demand in the developed countries for materials used in strategic fields such as renewable energy. This global recycling arrangement will be a cure also for the environmental and health related critique towards e-waste recycling in poor countries. The proposed method is to create a more appreciated, technology-intensive recycling industry by the formal hands in the industrialized countries: "These potentials can be realized by manual pretreatment in Nigeria and export of the fractions bearing precious metals to pyrometallurgical refineries in Europe, Canada or Japan" (Basel Convention, 2011b, p. XIV-XV). Shortage of precious raw materials, importance of recycling for green, sustainable economies, and provision of green employment opportunities are the major arguments that are used by the Basel documents, similar to the EU, EPA and Japan discourses, to gather positive support from the global public for this proposal.

Particularly for this purpose the SBC initiated Partnership for Action on Computing Equipment (PACE) in 2008. The multi-stakeholder nature of the partnership is frequently emphasized, that this partnership brings together various parties ranging from refurbishers to electronic manufacturers and governments. The aim is to "improve the current management of used and end-of-life computing equipment through the development of global refurbishment and material recovery/recycling guidelines on the environmentally sound management of computing equipment" with a particular focus on "developing countries and countries with economics in transition" (Basel Convention, 2011e, p.2). It is stated that the ultimate goal is "to promote sustainable development through efforts to repair, refurbish and reuse computing equipment worldwide." (Basel Convention, 2011e, p.2).

The SBC explicitly indicates that there is high hope for the implementation of the ban amendment in the near future (Basel Convention, 2012a). On the other hand, trade of used electronics is certainly not intended to be limited (Basel Convention, 2012b). Actually comments from parties like the US on the relevant documents show that there is pressure for fostering the trade of used and in working condition electronics as opposed to the ban of waste electronics the amendment aims for.

[44] For further information, please check section **3.2.1.5. Electronics Industry and Consumption.**

Looking from this point, it can be said that PACE constitutes the background argumentation for why trade of used electronics should be supported. Closure of the digital divide and technical assistance to developing countries for environmentally sound management of e-waste are the carrots promised to the developing countries, as well as the employment opportunities in refurbishment areas.

Finally, the SBC shares a similarity with the majority of the institutions that declare the intention to decrease waste generation: Although it is stated as a principle aim of the Convention, and that the SBC is fully aware that "the most effective way of protecting human health and the environment from the dangers posed by such(hazardous) wastes is the reduction of their generation to a minimum in terms of quantity and/or hazard potential", policies do not necessarily target a reduction of the amount of hazardous waste that is being generated (Basel Convention, 2011a, p.11-12). The new definition of waste as valuable resource and the accompanying emphasis in recycling can achieve reduction on the amount of waste that will otherwise be incinerated, but will not create a decrease on the patterns of waste generation.

5. Conclusions

During the process of finalizing this thesis the battery of my three year old, high-quality laptop stopped working all in a sudden. I have been a kind user; I have never carried it around as laptops are supposed to be and I have not used it often since I found PCs more comfortable to work on. Considering the relatively high price I paid and the good care I took, I was hopeful that we would be together without any problems for a longer time.

Only a couple of days later, the battery of my three year old mobile phone started to show the same troublesome symptoms. As my ICT devices made their first steps on the road to my personal history of the numerous electronic products I had to throw away, I could not help but feel disappointed: In spite of my careful attitude with my devices as an owner and my awareness on the issue as a result of my intellectual struggle for more than a year about e-waste, I was not able to escape from becoming a contributor to the problem. This personal experience has added one more brick to strengthen the primary argumentation of this thesis, that the e-waste issue is a problem at systemic level and necessitates transformation at systemic level.

Summary

This research has had three major aims. The first one was to understand the e-waste problem comprehensively. **Chapter 2** provided the three important and interlinked aspects of the issue that were addressed in the literature: **1.** Increasing volume of e-waste globally, **2.** Health and environmental damages that emerge due to the toxic materials e-waste involves, **3.** Trans-boundary movement of e-waste particularly from rich to poor countries and the damages these traffics create in the arrival locations.

The second aim was to construct a critical understanding of the more hidden structural mechanisms that cause, shape and continue the problem. **Chapter 3** provided a systemic overview of the critical arguments in the literature about sustainability issues – particularly e-waste, and the related policy proposals. I have concluded that the primary factors which create and sustain the problem are: **1.** The impact of highly praised ICT on the over-consumption of electronic products, **2.** The avoidance to acknowledge the role that over-consumption of electronics plays on e-waste problem, **3.** The dominant promotion of the technology-oriented solutions as a panacea for the problem, **4.** The normalizing effect this techno-centric approach can create on excessive consumption patterns, **5.** The role free trade paradigm of the conventional economics plays with fostering unsustainable consumption and disguised disposal, **6.** The avoidance to acknowledge the negative contribution of the free trade paradigm to sustainability issues.

The third and the most important aim was to assess whether the related organizations that develop e-waste policy proposals indeed address these root causes in their discourse, and whether their proposals cover all the aspects of the problem. **Chapter 4** provided the discourse analysis of the policy documentation from six e-waste related organizations. To summarize,

1. **The EU**'s emphasis is on developing a better e-waste management system, by imposing responsibilities on producers, so that they will deal with the costs. The Union has critical statements towards consumption in general, but does not really propose a concrete plan to address over-consumption of electronics. The definition of sustainable electronics consumption for the EU is continued consumption of electronics designed with energy and material efficiency. Recycling rises as top priority within the solution proposals; the Union states its goal to become a recycling society, which will bring great economic benefits and strategic advantages with raw material supplies of the EU.

2. **Greenpeace** focuses on the e-waste issue as a pollution problem and pressures electronics manufacturers to use less toxics. They propose to make electronics producers financially responsible from the recycling of their obsolete products. The consumption related statements are only related to the energy consumption of the IT sector.
3. **The US-EPA** refrains from discussing anything about the impact of consumption on the e-waste problem. Actually, 'Reduction' as a method for tackling with waste is completely avoided. A striking difference of the language of the EPA discourse is that participation of the related actors to improve the e-waste problem is completely on a voluntary basis. Also, because US Government refrains from interference, there are no strong rules or regulations proposed. Government can only 'motivate, support, provide' stakeholders for participation to solve the e-waste issue.
   EPA is against limits on the trade of e-waste but it is willing to establish partnerships with the recipient countries to help them better manage the inflows of e-waste. The US Government may consider ratifying the Basel Convention, but in response pressures the Convention to facilitate trans-boundary movement of used electronics.
4. **The Japanese Ministry of Environment** has critical statements towards consumption in general, but does not really propose a concrete plan to address over-consumption of electronics. The Japanese culture is emphasized as an important driver of their sustainability approach and the difference of Japan from the Western world is pointed out. Lack of English language documents on e-waste makes it difficult to get a further understanding of Japan's position on the e-waste debate.
5. **StEP Initiative** aims to develop comprehensive proposals on the issue and situates itself as an important multi-stakeholder platform. However, there are no environmental NGOs as representers of environment's interests among the members. Also, the two well-known and active NGOs on e-waste, which are strongly against e-waste trade and critical of electronics consumption, are not members as well. Different from the other organizations StEP announces its intention to develop policies to tackle with the sources of e-waste generation, such as planned obsolescence. The approach is techno-centric (by redesign), but the aims involve reduction of e-waste generation.
6. **The Basel Convention** wants to take a larger role on the e-waste policy-making and decides to widen its approach. The primary focus will not be only the trans-boundary movement anymore. The organization calls for a paradigm shift especially in the developed world to see waste as a resource. A global division of labor is suggested for successful transformation in line with the paradigm shift: the labor-intensive labor of e-waste recycling will be done in developing countries, while the more complicated steps that need well established high-tech systems will be handled in the industrialized countries.

Discussion

Once the similarities of the discourses are brought together, we can see that a kind of consensus on e-waste has been reached between the governmental actors (particularly the EU, EPA and Basel Convention) for a (formal) global system of e-waste management. This system does not really aim to reduce e-waste generation, therefore does not involve pressure on the planned obsolescence strategy of the electronics manufacturers or consumption of electronics on its own. It will be a system based on development of new technologies as a solution and certainly does not aim to ban the trans-boundary movement of obsolete electronics. In contrast, if they are in working conditions, trade of used electronics should be facilitated.

The dynamics of the system will be as follows: From the discourse of EPA and the EU, we understand that recycling emerges as the panacea and overlaps perfectly with the increasing concerns especially in the Western world for the long-term security of raw materials that are very crucial for particularly renewable energy production. So recycling has a strategic and political importance as well for (Western) countries in the long-term. However to gain support of the wider circles, including business environment and the public, perceptions on e-waste need to be changed in the Western world (to see it more as a valuable source). That is why governmental and intergovernmental organizations like the EU, EPA and the Basel Convention and NGO StEP frequently emphasize the possible employment opportunities and economic benefits of recycling in developed countries: Promise for more 'jobs' and more 'money' will certainly attract the support of masses.

Recycling can be economically the best option for non-working devices, but it would be a loss of value for second-hand electronics, which are discarded but in working conditions. They can still be used for some time, before being treated as waste. 'Demand for cheap electronics in developing countries', 'assisting the developing world to bridge their digital divide' then become the two convincing arguments, to show that trans-boundary movement of used electronics is necessary and useful for the developing world. By this way, an international formal market for second hand electronics will be created and the increasing supply of used electronics in developed countries will turn into an opportunity. Besides, the increasing consumption patterns of electronics in developed countries can also be sustained, because it would be easier and probably more profitable to get rid of old, unwanted electronics and get a new version.

Another 'positive outcome' of this scenario will be the facilitation of a global division of labor. When these second-hand electronics turn into e-waste, the labor intensive parts of e-waste recycling, such as dismantling of components will be done in developing countries where labor wages are very low compared to the industrialized world. 'New employment opportunities' and 'new sources of income' become the convincing argument for developing countries.

Thus, it can be concluded that future security of rare raw materials and global division of labor are the two driving forces of this consensus proposal for the e-waste problem. However, whether it really addresses sustainability is open to question.

However as long as the causes of the increasing supply of e-waste are not targeted, global e-waste problem turns into a regional problem of the recipient developing countries. That is why the focus of the Basel Convention, which is the most relevant international institution on the issue, gets centered on the African and Asia-Pacific e-waste management cases. The institution asserts that the basic aim is to monitor more clearly how e-waste is handled, and assist the countries in these regions with better technology and expertise of the developed world. However, more directly, the real question this approach tackles with is *How to assist the recipient countries to deal with the responsibility of the whole world*. With this attitude the e-waste problem loses its global characteristics and transforms into another region specific problem of the global South, almost like poverty or inequality. By this way, the sustainability problem created by the excessive consumption patterns of the throw-away societies will be relocated to other parts of the world.

Limitations

The lack of English language policy documents on e-waste has made it difficult to have a more concrete understanding of Japan's position in the e-waste debate. It is for sure one of the most important actors, especially with its impact on the e-waste situation for the Asia-Pacific region. Therefore a more sound analysis of the e-waste discourses necessitates a better understanding of the Japanese approach.

From a methodological perspective, conducting interviews with authorities from the organizations could have added more insight to the story and could have decreased the distance

between me as a researcher and the research objects as the organizations. However, considering the large amount of literature I have covered, there was no time left for interviews, etc.

Finally, aiming to cover all the aspects of the story with a broad perspective, which I believe is a positive side of this research, might have also resulted with the loss of some nuances. These nuances can create cases which can contradict with the main argumentations of this thesis.

For future research

1. Assuming that in the short to mid-term, this proposed system is put into practice, an interesting point that I believe should be investigated is whether this system can abolish the informal economy of e-waste handling in the recipient countries. The health and environmental damages of e-waste emerges due to the improper handling of e-waste by the informal sector. By the global division of labor and technology support from developed countries through this system, it is believed that the informal sector can be transformed and environmental damages can be abolished. However, it is highly questionable whether technology can solve problems like informal economy that are essentially socio-economic.

2. I personally believe that product longevity proposal can bring a substantial improvement for the e-waste problem. Unfortunately, as the thesis shows it is not supported by the majority of the policy making. It would be interesting to research whether electronics industry can embrace it and the dynamics necessary to foster such a transformation. So, the future of product longevity for electronics industry can be analyzed. This research topic can fit very well within the Innovation Sciences field.

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